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POPULAR MECHANICS

AUG. 1969
50 CENTS

How
To Have
Good TV in
Every Room
Page 126

Maverick vs the Mob

How Ford's Fancy Little

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Against Foreign

'Friends' Page 73



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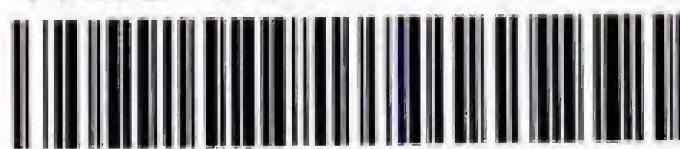
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LETTERS TO THE EDITOR

Has to be the best

The painting on pages 112 and 113 of your June issue (*Damn the Submarines! Turn on the Lights!*) has to be, by far, the finest depiction of air and sea action I've ever seen! Fabulous!

Can't quite make out the artist's name, but he deserves a 21-gun salute.

HAMDEN, CONN.

VINCENT SHRIBER

We rarely fire guns around the office, so instead of saluting our artist, we paid him this time. His name is Ed Valigursky, (see the last line on page 111), and, we agree, he did a superb job.

In fact, the painting was so good we presented the original to the Chief of Naval Operations, and it now hangs in the Pentagon.

Anybody see Lola?

In your June story on Cam-Am racing (*Road Racing's Big Big League*, page 77, June PM), the caption on page 78 under the picture of Mark Donohue (you spelled his name wrong) says he is series champ. He never has been a Can-Am champ, but he has been USRRC champ.

Also, the car he is identified with is not a Lola; it is his last year's McLaren Mk 6B. The Lola 160 car has yet to prove itself in competition, where you state it proved impressive last year.

It bugs me when such gross inaccuracies appear in print in magazines that should know better—especially under Dan Gurney's byline.

MOTOR AGE
PHILADELPHIA

STAN STEPHENSON
MANAGING EDITOR

The caption is a staffer's, and he's now helping with the sweeping chores at night.

No. 6 is fifth

I hope that your Saturday mechanics have not purchased new distributor cams, since according to *How to Check Distributor Vacuum Advance* (page 152, May PM), a timing variation of more than 3° in cylinders that are actually 180° apart would indicate a worn distributor cam.

On page 216, you say "... disconnect the timing light from No. 1 cylinder and connect it to the sparkplug of the alternately firing cylinder. On V8 engines, this will be No. 5 cylinder in the firing order." The only cylinder using the same timing

(Please turn to page 8)

POPULAR MECHANICS

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LETTERS

(Continued from page 6)

mark is No. 6—or the fifth cylinder in the firing order. No. 1 and No. 5 are 180° apart.
LEEDS, ALA. H. M. STEIN

It's a confusing situation, with confusion further compounded by our use of "No 5" when we should have said "fifth." In a V8, firing order goes this way: Nos. 1, 8, 4, 3, 6, 5, 7, 2. Thus, the fifth cylinder to fire is No. 6!

Longer years in Germany?

Was ist los? We know the Germans for an industrious people. But how much time does Heinz Schneider (*Suits of Shining Armor from the Junkyard*, page 129, June PM) devote to his selling job when he spends 10,000 hours a year making armor (50 suits at 200 hours per suit)?

In the United States there are only about 8760 hours in a year.
HINCKLEY, OHIO JOHN ASCHERL

There's a very complicated formula that explains it all, but it has to be worked out by a guy who can't add.

Good old days department

Those good old days are back again. Both John Bentley (*So What Else Is New?* page 114, Feb. PM) and Don B. Harding (*Letters*, page 6, May PM) made a small error in their comments on the Cadillac.

The 1912 Cadillac was the first with an electric starter. The first Cadillac V8 was in the 1915 model—also the first left-hand drive.

Have been a reader of PM for over 50 years; hope you will be on the job 50 years from now.
BREMERTON, WASH. O. J. POTTER

I worked as a mechanic from 1916 to 1940 and serviced quite a few Cadillacs. I owned six old ones, the first, a 1913 model.

The 1911 Cadillac had a compressed-air starter that didn't always work. The 1911, '13 and '14 all had copper-water-jacket-covered cylinders and were right-hand drives.

The 1913 was the first to have an electric starter.

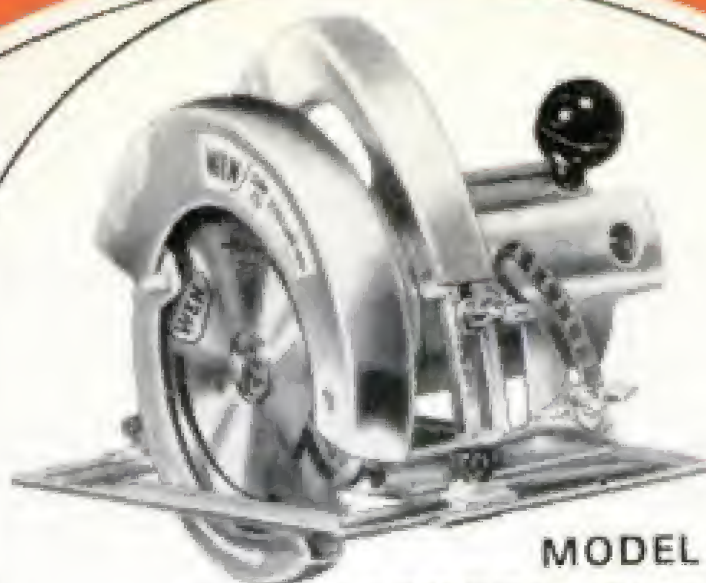
The 1914 was different from the 1913. It had a two-speed rear end. The Model 53 (1915) was the first eight-cylinder, not the 1914.

I've had good, modern cars since 1930, but my heart is still with some of those old gals.

BRIDGEPORT, VT.

ROBERT R. MUNDY

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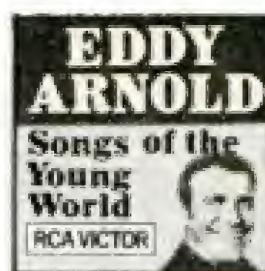
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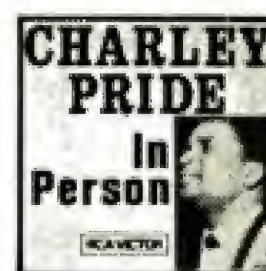
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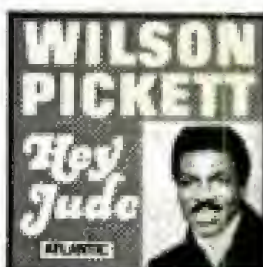
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TRAILER COACH ONLY 8 FEET LONG? Yes, Little Fella, a new eight-foot travel trailer (10 feet overall, including tongue) sleeps four to six persons, has a compact kitchen range, sink, 75-pound icebox, 22-gallon water tank, 12-volt lights and a chemical toilet in a separate compartment. A swing-out back section handles *extra* sleepers. Little Fella runs away with *most-compact-design* of the year. Aimed at owners of 4x4 vehicles, the unit has rear *skid-plates* to prevent damage while being towed through rough country. (McNamee Coach Corp., 2501 Rosemead Blvd., South El Monte, Calif.)

NEW LOW-PROFILE, ROOFTOP AIRCONDITIONER for RVs cuts down on wind drag and eliminates the usual unsightly and unwanted limb-snagger on the coach roof. It's the Polar-Pal Mach I from Coleman Co. The sleek, aerodynamically designed cover is of supertough ABS plastic. Total weight for unit: 125 pounds. It'll fit into any standard 14 by 14-inch roof opening (vent-sized), and project only 1½ inches into headspace of coach. The Mach I delivers 10,000 B.T.U.s, and cold airflow is easily directed or divided to four directions. Filtered continuously, Polar-Pal has built-in thermostat and E-Z Start Kit (reduces motor-starting effort).

DON'T TILT THAT HITCH-BALL! Draw-Tite, world's largest hitchmaker, warns that a tilt angle of more than 5° off perpendicular will destroy the hitch-ball's ability to pivot freely as the designers intended. The firm claims that "most hitch-ball failures are induced by failure to maintain the ball in a perpendicular position." Company experts also warned users not to *over-tighten* the hitch-ball nut. Using an extra-long wrench handle stresses hitch-ball shank critically. It may snap under sudden strain that it normally could absorb. Draw-Tite's advice: Use maximum handle length of 12 inches when tightening shank-nut.

OWN A SELF-CONTAINED COACH? Then you know that storage of flexible sewer hose is a problem. One way to cut down on space needed is to use the new vinyl-coated *compressible* sewer hose constructed of high-tensile spring steel. A 10-foot length squeezes down to 20 inches. It's so new you may have to write the maker about availability: Airco Chemical & Plastics, Room 327, 150 East 42nd St., New York, N.Y. 10017.

FUEL CELLS FOR CAMPING VEHICLES? Safety experts would like to see the aircraft technique utilized on recreational vehicles. In that system, urethane-foam inserts are stuffed inside gasoline tanks. The "foam cells" absorb gasoline without robbing much interior volume. In event of fuel-tank rupture, the foam cells will not allow sudden loss of fuel—thus averting an explosion.

WINNEBAGO INDUSTRIES SELLS \$2 MILLION IN RVs IN ONE WEEK! That is probably a new all-time record. One week in mid-May the company's total sales of Winnebago motor homes, travel trailers, pickup coaches and tent-trailers reached that astonishing volume. One company official described it as "exciting—but somewhat frightening!" Despite the fact that Winnebago has an almost completely automated factory (in Forest City, Iowa), its chief problem ahead will be greater production. ★ ★ ★

TOM McCAHILL SAYS:

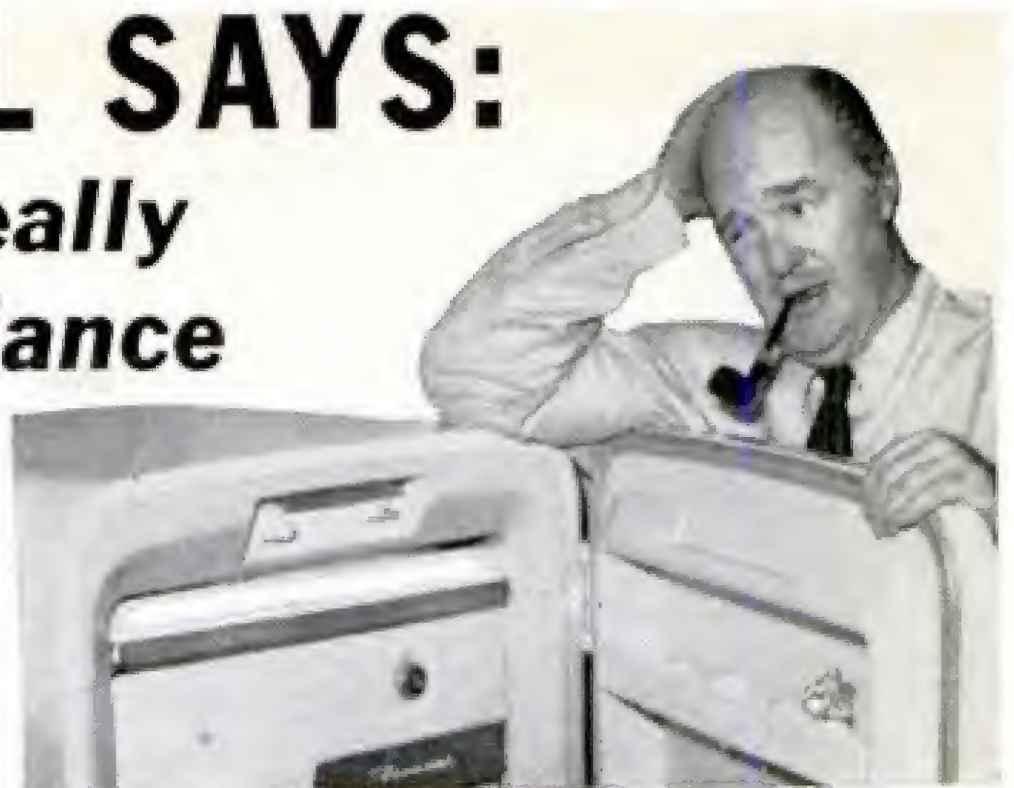
"A Smart Guy Can Really Clean Up in the Appliance Repair Field"

Those electrical gadgets you have around your house are great on convenience, but if you're like a lot of do-it-tomorrow Johnnies, you don't know where to turn when one breaks down. So you call one of the busy Appliance Servicemen in your town, then drink instant until that fancy automatic coffee pot is perking again.

People have so many electrical appliances, it's no wonder Appliance Repairmen are busy as a bear in a bee nest. Count yours. The average home has at least a dozen, maybe more. There are better than 800 million appliances in the U.S.A. right now. No wonder the man who knows how to service appliances properly is pocketing \$4 to \$6 an hour, for as many hours as he cares to work!

If you're interested in making money (and who isn't), here is a job field crying for good men. And it's no sweat at all to get the training you need. Thousands have trained with National Radio Institute's Appliance Division. NRI has a great, low-cost home-study program covering every type of Appliance repair in detail. You study at home, in your spare time, learning through actual practice how to fix home, commercial and farm appliances. And not just the little stuff, either. Besides cantankerous coffee pots and toasters, you can learn how to repair air conditioners, refrigeration equipment, even small gasoline engines—and that's where the big bucks are, in the major appliances you'll fix.

NRI is one of the biggest and best schools in the home-study field. They have this Appliance Servicing course worked out to the most nit-picking detail. Yet, you'll be amazed at how little it costs. You even get a 25-buck professional Appliance Tester without extra cost. With your Tester and a few basic tools you probably have in your house, you'll be doing repair work long before you finish the course. And you can work anywhere—



in a corner of your basement, in the garage, even on the kitchen table.

NRI has been in home-study education since 1914. Experienced, well-trained instructors on the staff of 150 in Washington, D. C., give you all the personal attention a man could ask. You don't even need a high school diploma. Take it from Uncle Tom . . . this can be one of the easiest and most rewarding businesses you'll find today, either full-time or in spare hours. As a matter of fact, knowing how to service Electrical Appliances can pay off even if you don't want to strike out on your own. That coffee pot on the fritz probably needed ten minutes of a repairman's time to be perking again like the mudpots in Yellowstone Park. You can do it yourself with the training NRI gives you. And if you're thinking about Social Security years, this is a great way to pick up some money and keep yourself busy at the same time.

There's nothing to lose except a postage stamp and the energy it takes to walk to the mailbox. What you'll get for your efforts is the newest NRI Appliance Servicing catalog. Nobody is going to ring your doorbell to pressure you into signing an enrollment blank. NRI doesn't employ salesmen.

Do yourself a favor and mail the coupon now—before you turn this page.

Tom McCahill

NATIONAL RADIO INSTITUTE, APPLIANCE DIVISION
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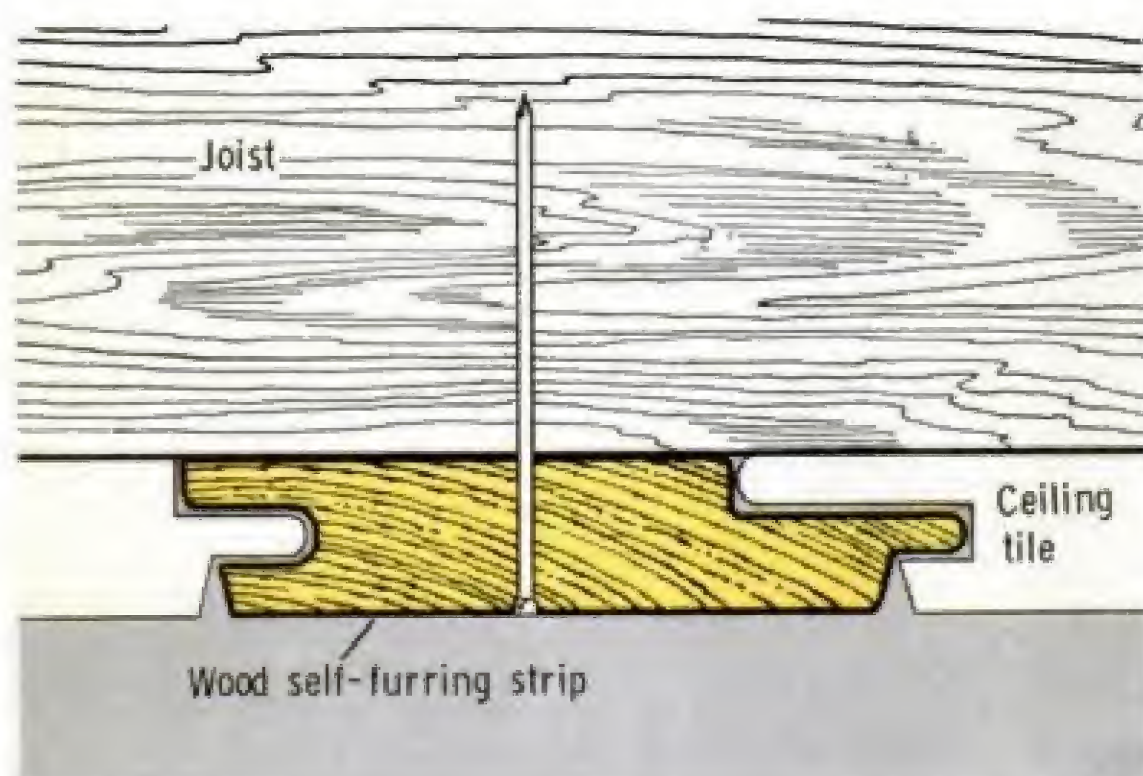
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☐ Check for facts on new GI Bill.

New Building Products You Should Know About

DEEP SHADOW LINES and random tabs of this new asphalt shingle produce the rugged look of a wood-shake roof. Known as Barrett Traditional Shake asphalt shingles, the material comes in three colors: Cedartone (simulating weathered wood); Slatetone (a rich gray-blue), and Woodtone (a blend of brown and tan granules). All are available from the Celotex Corp., 1500 N. Dale Mabry, Tampa, Fla. 33607. These shingles also can be found at building supply dealers and retail lumberyards. The shakes make an attractive roof finish for vacation homes and other shelters.

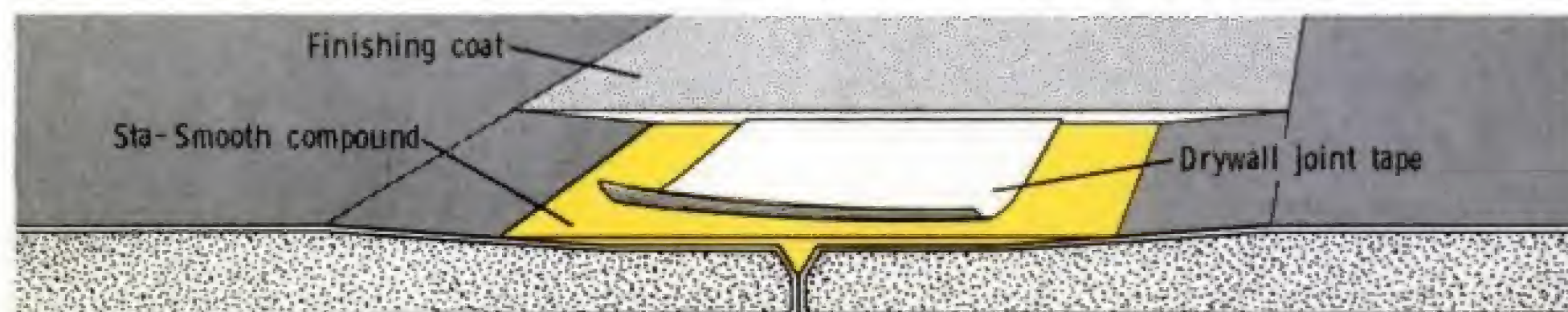


WHETHER YOU'RE PLANNING to cover an old ceiling or finish a new one in a room addition, the Beam-Line Ceiling Tile System is ready to do the job neatly and quickly. It uses walnut-grained beams that double as furring strips while holding 16x16-in. tongue-and-groove Insulite ceiling tiles in place. Beveled edges of the tiles slip into the grooved "exposed" beams as shown in the sketch at left. These 1/2x2-in. beams are available in standard 8-ft. lengths. The system is manufactured by Boise Cascade Building Products, Box 7727, Boise, Idaho.

DISTINCTIVE ACCENT PANELS for interior walls are provided by Marlite's new Textured Carved Leaf planks. These planks can be alternated with other Marlite textured planks to gain an interesting wall effect. They are satin-finished in light and dark tones, 1/4 x 16 x 96 in. in size, and can be installed with adhesive or concealed metal clips over furring strips or old wall coverings. Only an occasional damp wiping is required to clean these plastic-finished hardboard planks made by Marlite Paneling, Dover, Ohio 44622 and available at building supply and lumberyards.



A FAST-HARDENING COMPOUND that's designed to fill the V-joint between wallboard panels, as well as to bed the tape joint, is Star-Smooth, which has been developed especially for use with the manufacturer's line of wallboard products. This material becomes hard in 1 1/2 hours to produce a firm bond with minimum shrinkage, after which a first and second finishing coat will complete the job. In addition, Star-Smooth Compound can be applied as the first coat on nail or screwheads, corner beads or casing beads, and also can be used when you're taping inside corners. It's made by National Gypsum Co., Buffalo, N.Y. 14225.



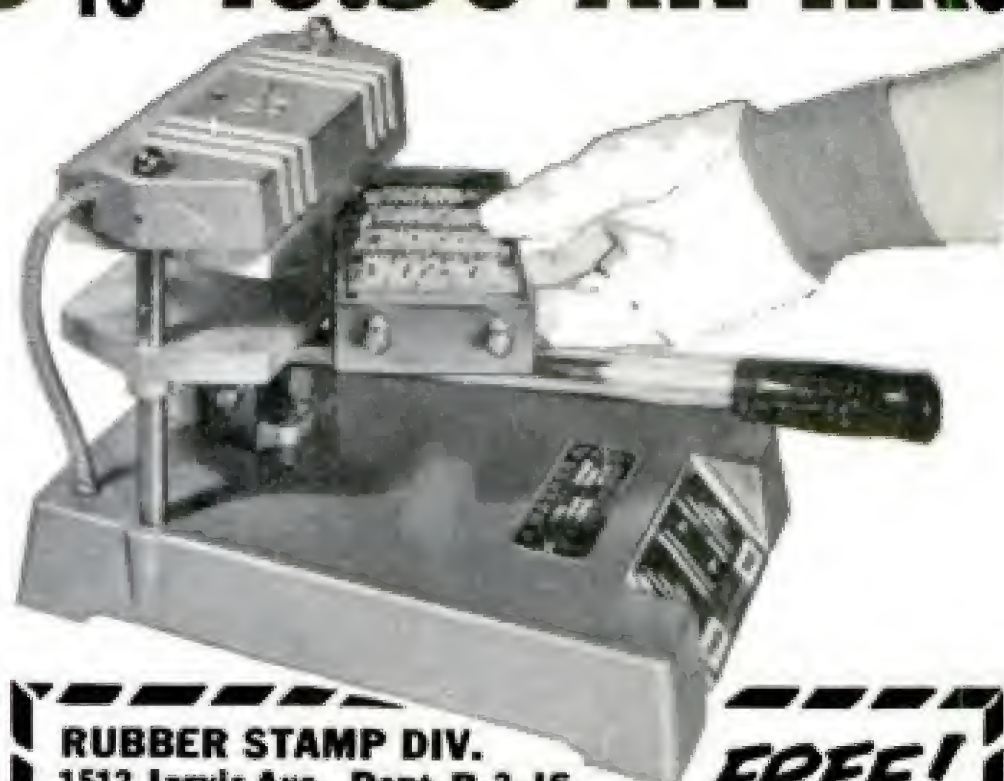
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Weed seeds can kill mosquitoes. That report comes from the University of California at Riverside, where scientists discovered that mosquito larvae became stuck to certain weed seeds that had been dropped into lab bug hatcheries. The larvae invariably died, hopelessly glued to seeds that emit a mucilage upon contact with water. The scientists estimate that a pound of seed from a weed called shepherd's purse could eliminate 25 million larvae in a typical marshy breeding ground.

Earthquake toll in the United States from 1865 to 1966: over 1500 deaths and more than \$1.3 billion in property damage. Those facts are in a new publication, *Earthquake Investigation in the United States*, published by the National Earthquake Information Center of the Coast and Geodetic Survey. Most deaths for any state—935—occurred in California.

A small electric refrigerator shaped like a crash helmet has been developed by Soviet scientists for use in the operating room. It's designed to cool a patient's brain so that operations on the heart and other vital organs can be carried out with maximum safety. When the brain is cool, its oxygen requirements drop. The Russians claim their icy helmet can lower brain temperature to 72°F. in less than three minutes.

Oceanographers with healthy bank accounts might be interested in a new 50-volume reprint of a study of the sea originally published in England in the 19th century. Based on findings made during a three-and-a-half-year circumnavigation of the globe by H.M.S. *Challenger*, the study was produced by 76 scholars from many different countries. The reprint, which contains 29,500 pages and hundreds of illustrations, is priced at \$3850 by its New York publisher.

Holography is the key to a new information storage and retrieval system invented by a Connecticut scientist. He says that 1000 standard-sized book pages can be stored in a crystal only two inches square and a quarter-inch thick. Intense light from a laser is split, creating two beams, one of which is the information carrier. The two beams intersect at the storage "cube," which is composed of alkali halide crystals with colored centers. Certain wavelengths in the laser beams cause the color centers to change state, forming holograms. To obtain projected images of individual pages, all the librarian has to do is hit the cube with a laser beam.

One of the world's "most prolific" oil reserves may lie beneath the continental shelf between Taiwan and Japan. That's the opinion of U.S. geologists and oceanographers, and scientists from Nationalist China, Korea and Japan. The experts recently jointly investigated the area, recommending further detailed seismic surveys. The region is said to be equal in size to the combined areas of Texas, Oklahoma and New Mexico.

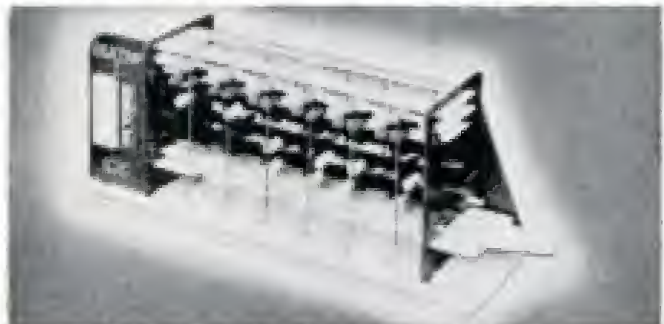
Any fresh meat will spoil if you don't refrigerate it. That's common knowledge. But it ain't necessarily so, according to researchers at Ohio State University, Columbus. As proof they can exhibit a chunk of fresh, juicy beef in a sealed test tube. Yet the meat is five years old. It contains no preservatives and is stored at room temperature. The secret is that the beef is sterile. It was taken from a freshly slaughtered animal under almost surgically sterile conditions and packed into a sterile test tube containing nitrogen. The inert gas replaced air in the tube, thus keeping out bacteria. The experiment is part of an investigation by OSU scientists into why and how meat deteriorates. Ten pounds of similar meat, slaughtered at about the same time, was sold to a leading research institute for experimental purposes. Cost: \$300 a pound. ★★★



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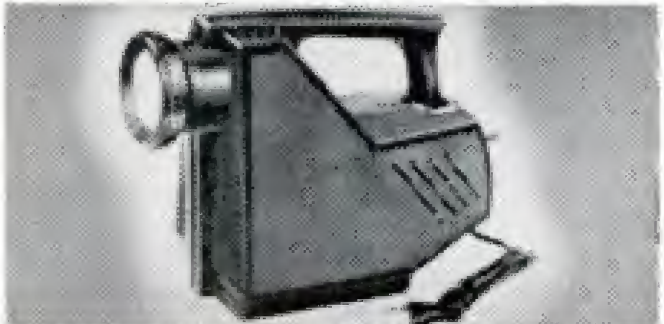
Now go treasure hunting on the bottom! Great idea! Fascinating fun and sometimes tremendously profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along the bottom—your "treasure" haul can be out-board motors, anchors, fishing tackle, all kinds of metal valuables. 5-lb. Magnet is war surplus—Alnico V Type—Gov't cost \$50. Lifts over 150 lbs. on land—much greater weights under water.

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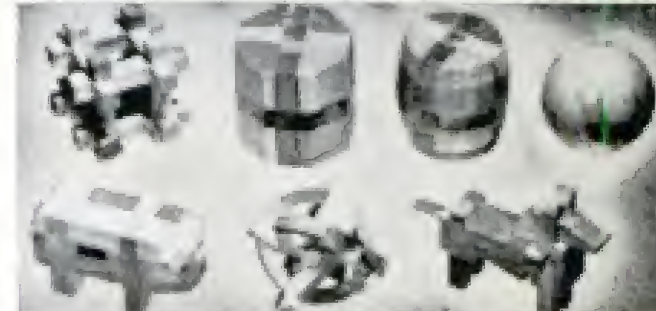


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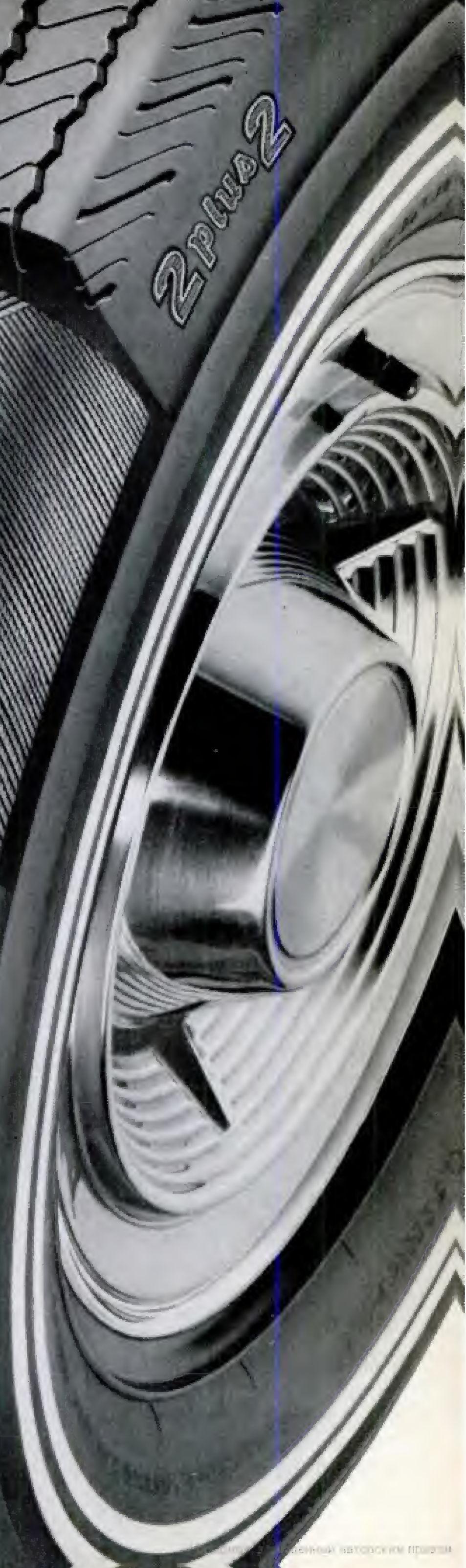
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Drivin' with Dan

What will the U.S. Grand Prix pay this year? How do you feel about so-called auto stabilizers? What will the Ferrari be like in the new Can-Am Series? Dan Gurney answers these and other automotive questions



MOMENTS BEFORE THE START of the Indianapolis 500, PM's editor, Bob Crossley, listens in on a last-minute communication between Dan Gurney and Eagle team members Wayne Leary (left) and Hardy Allen (center). The Popular Mechanics sticker on car rode with Dan to second-place finish at an average speed of 155.337 mph, several mph faster than last year's winning speed in the Memorial Day race

Q. I understand you had to remove Popular Mechanics stickers that were to appear on your No. 48 car and Denny Hulme's No. 42 at Indy. How come?—Bob Greenblatt, Irvington, N.J.

A. We had to peel them off at the behest of the United States Auto Club which has a requirement that no one can have a sticker on a car unless they are a member of USAC. The logotypes went back on the cars the morning

of the 500, however, after PM officially joined the club.

Q. I think the stock-block engine is the only way to go at Indy, and I was bragging to a friend that your two consecutive seconds are a record at the speedway. Isn't that true?—Herb Perry, Tacoma, Wash.

A. I appreciate the support, Herb, but there are three other gentlemen who achieved two consecutive seconds at Indy: Bill Holland in 1947-48, Rex Mays in 1940-41, and Harry Hartz in 1922-23. There are also those who have done even better than back-to-back seconds, such as Wilbur Shaw's 1937, '39 and '40 victories and Bill Vukovich's consecutive wins in 1953-54. We were still operating at a deficit of more than 100 hp this year, however, and if the stock-block engine is to be competitive at Indy, the limit must be raised from 320 to 366-cu.-in. displacement.

Q. Does the United States Grand Prix pay \$50,000 total purse, or \$50,000 to win this year?—Bruce Barnett, Grand Rapids, Mich.

A. It is \$50,000 to the winner, by far the largest Grand Prix payoff in history. The total purse announced is \$206,000, ranking the Glen ahead of all races except Indy from a payoff standpoint.

Q. Do you like Trans-Am racing? I do, but some of my friends kid me about it being "minor league."—Dale Phillips, Chicago, Ill.

A. I like Trans-Am racing very much, both as a spectator and competitor. Although it does not have the big purses that some other types of racing award, it commands a lot of attention from Detroit and probably is as highly regarded by some manufacturers as

(Please turn to page 26)



I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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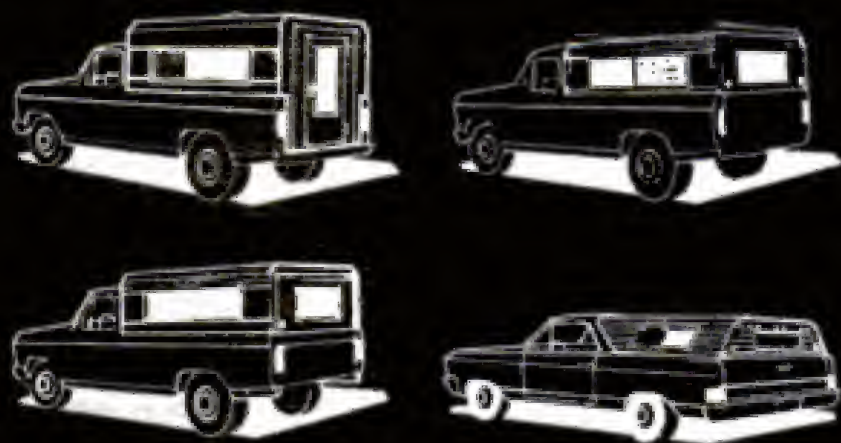
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DRIVIN' WITH DAN

(Continued from page 24)

any competition. I think you will see an increasing number of top drivers and teams competing in Trans-Am.

Q. Have you had a chance to test any of the so-called auto stabilizers that have appeared recently? They consist of a weight suspended in a rectangular box that mounts in the automobile trunk. I believe a couple of sash weights would be as effective. What do you think?—Howard Weaver, Circleville, Ohio.

A. No, I haven't tried any of these devices. I only know that for any action there is an opposite and equal reaction. Also, you don't seem to get something for nothing these days. I have a feeling that all that monkey-motion is a waste of time.

Q. I can appreciate the fact that you have to run where the money is, but can't you find time for just a couple of Grand Prix races this year—especially the American? And what kind of car might you be in?—L.O. Broderick, Boston, Mass.

A. I would certainly love to do that, and first of all with our Eagle. Although we have continued development of our V12 to the point that it looks competitive with anything in Formula 1 right now, I doubt that it would be possible to field our own car at Watkins Glen this year. I am seriously considering driving in the American Grand Prix for another team, but at this point I'm not sure which one it might be.

Q. What do they call the Ferrari that is supposed to run in the Can-Am series this year? And what will it be like?—Jerry Overbrook, Milwaukee, Wis.

A. It probably will be a slightly modified version of the car that showed up at Las Vegas last year. They call it the Ferrari 612. It was powered by a four-valved V12, with 380-cu.-in. displacement and an estimated 600+ hp. It also carried a mounted wing at the rear, and probably will be seen with Chris Amon driving it in at least a few of this year's Can-Am events.

Q. What is a Can-Am race, and what other kind of cars besides your McEagle are used in this race?—David Nash, Eau Galli, Fla.

A. A Can-Am race is one of a group of races

(Please turn to page 28)

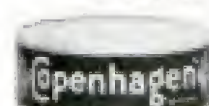
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DRIVIN' WITH DAN

(Continued from page 26)

officially named the Canadian-American Challenge Cup Series. This year there are eleven races on the calendar. They have FIA sanction so they are open to international racing drivers. The cars must have fenders, two seats, on-board starting, and they must run on pumped gas. Otherwise, the design is practically free. Any sort of piston engine is eligible for use. If you'd like to read more about Can-Am racing, take a look at my article, *Road Racing's Big Big League*, in the June PM (page 77). The article describes the cars and drivers in Can-Am competition and gives a calendar of races.

Q. Does USAC allow Formula I-type wings on championship cars?—Mike Bump, Broadalbin, N.Y.

A. USAC does not allow wings unless they are part of the body. They cannot be over 36 inches high. The wings have recently been banned in F-1 because they proved to be too unreliable. The suspension-mounted wings seem to break with regularity, causing very serious accidents.

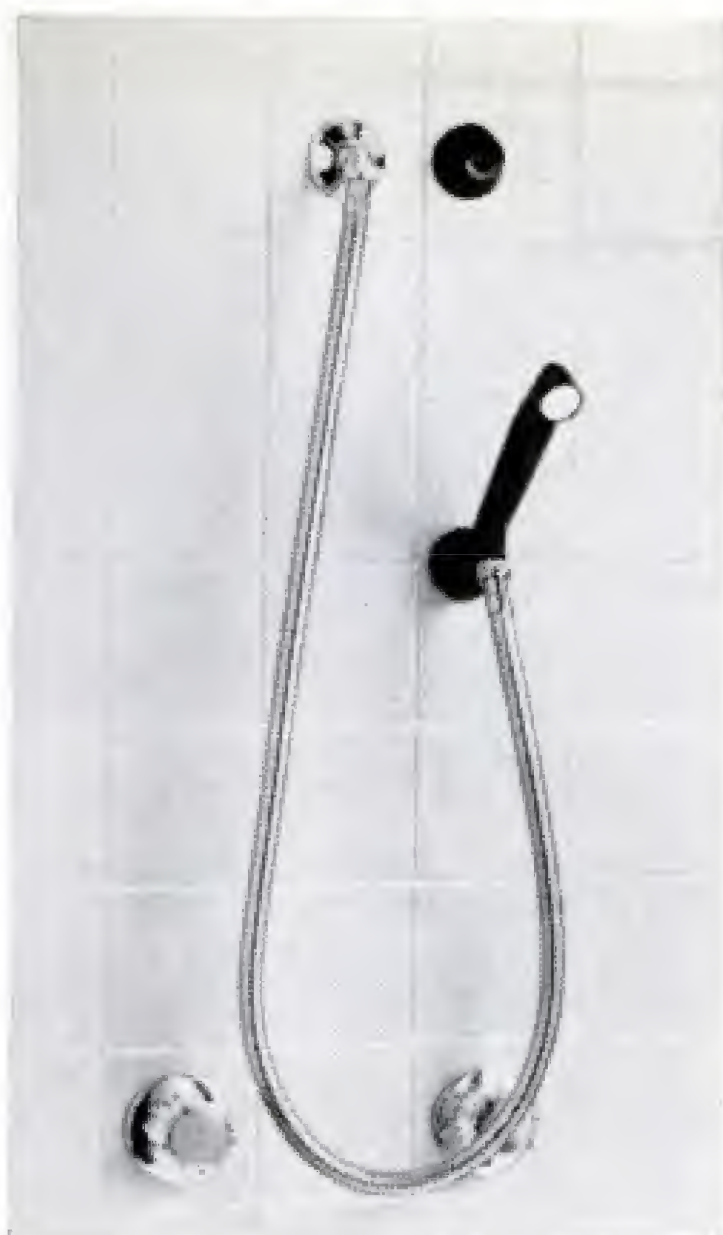
Q. Why did Ford stop making the 352-cu.-in. V8? Is it a good engine to supe up?—Mike Stock, Sarnia, Canada.

A. I think the 352 was part of the same family of engines that spawned the 390, 406, and the 427 Ford. The 427 has been a great racing engine for Ford. The 352 was never very popular, and I think the speed equipment for it is scarce. The new 351 is a much better bet.

Q. I have a 289 Mustang and was passed and left on a slightly curvy road by what I thought was a Toyota. My friend said it was a BMW 2000. Do you think it was hopped up?—Curtis Benjamin, Asheville, N.C.

A. The BMW 2000 is a fine little German car and one of Europe's very best all-around performers. Chances are it was "stock." However, it probably cost quite a bit more than your Mustang, which could be modified fairly inexpensively, if that is any comfort to you. ★★★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 66).



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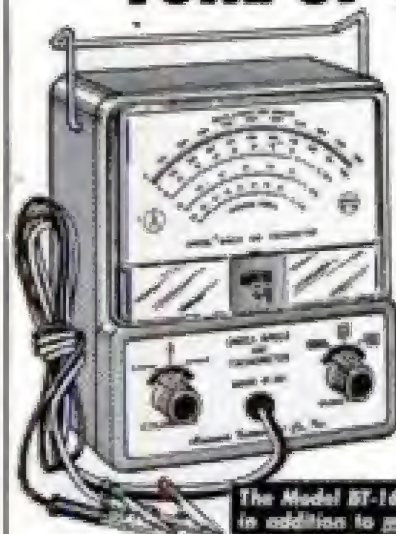
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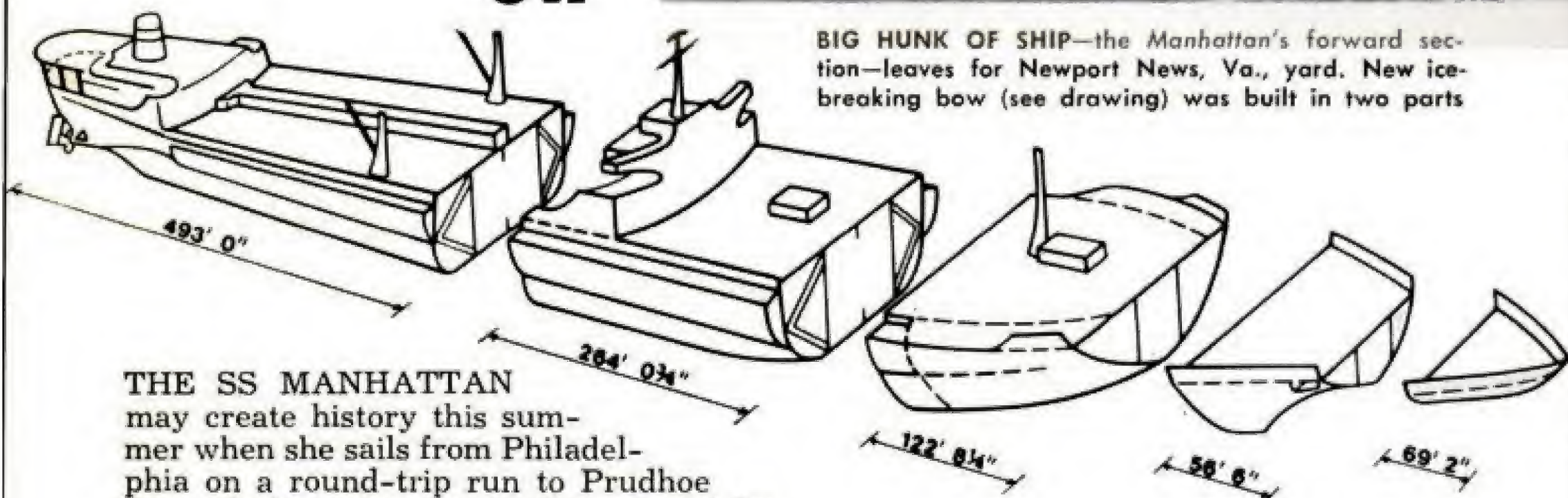
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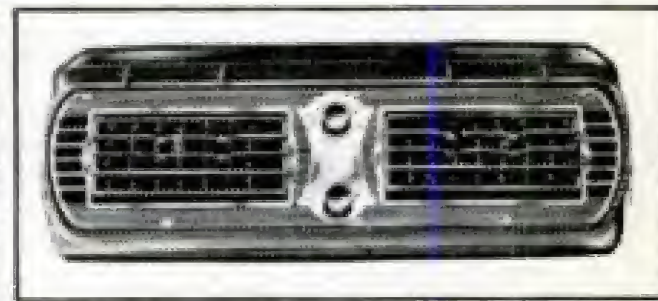
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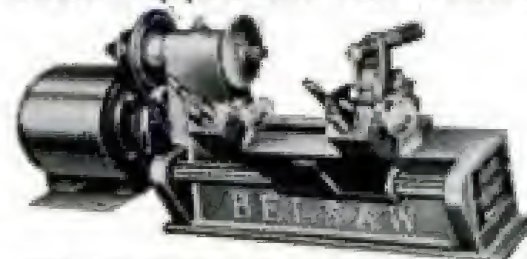
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LISTENING POST

BY BILL KILPATRICK

CHRYSLER WILL DIVE into the so-called subcompact market in another year or so with two small cars, one a Plymouth, the other a Dodge. Cars will be all new, not rehashes of Chrysler's French-made Simca line. Brass has been dragging its feet re this particular market segment, even now won't confirm or deny the chatter around town. But look for two new cars, maybe as early as the '71 models.

FORD'S MAVERICK, reported alive and well in the marketplace, will definitely have a smaller running mate by '71. The new car, code-named Phoenix, has been given the green light, meaning production plans are underway. Many observers thought the car would be sidetracked—even abandoned—if Maverick proved something less than a smash sales success. But Ford management is said to have a "damn the torpedoes" attitude about the Phoenix, feeling it can succeed regardless of how well the Maverick sells. The new car—sized and priced right along with the VW Beetle and, say, the Toyota Corolla—will be a four-banger with a minimum option list.

Speaking of option lists, by the time this appears Ford might well be offering a V8 option for the Maverick, possibly a mildly reworked version of the 302. As mentioned here a month or so ago, the dearth of Maverick options has driven owners to specialty shops and service stations. But now Ford dealers are pressuring the factory to bring out an exclusive line of options and accessories for the car a waggish peer of mine has dubbed the Henry F.

OLDSMOBILE may pop with a new wiper/washer option for certain of its '70 models. GM has for some time been looking into the possibility of locating the controls somewhere other than the dash, the idea being that the present setup is awkward, requires leaning forward, fumbling in potential emergency situations (for example, splashed and blinding slush). Olds and Pontiac have been doing most of the active work, with Olds given the nod on a "let's see" basis. So, look for Lansing to offer a steering column-mounted arrangement, again possibly on the cars debuting next month.

AMERICAN MOTORS will drop the "Rambler" name from its line of cars this year, meaning the end of a link that goes back to the earliest days of American motoring. The first Rambler appeared shortly after the turn of the century, and the name has popped up on and off ever since. Decision to drop the name was made because AMC feels Rambler doesn't project the company's new image. Once again nostalgia bites the dust.

OLDER TEENAGERS won't like this a bit, but studies made and reported by a University of Michigan psychologist show them to be the most dangerous drivers on the road. Dr. Donald C. Pelz, of the University's Survey Research Center, reported that drivers aged 18 to 20 had more crashes and received more traffic citations than any other age group studied. Oddly enough, and contrary to popular opinion, Dr. Pelz said beginning male drivers—those aged 16-17—tend to drive cautiously.

"They were also driving less," Dr. Pelz pointed out, "but that fact alone did not account for their relatively low rate of infractions. Upon moving up to ages 18 to 20, they not only drove more but also became bolder and began incurring crashes and tickets in excess of what could be expected from their additional mileage."

Dr. Pelz said that young men who had been driving two years tend to be self-confident about their ability, but that their actual experience on the road was not sufficient to justify this confidence.

In the group studied by Dr. Pelz, he reported, "The onset of adulthood just before 21 was an intersection point of several motivational trends—hostility and thrill-seeking were still high, driving confidence was rising, and life changes and new responsibilities

were maximum. This turbulent combination may help explain the excessive hazard of the 18-to-20-year-old male."

SLOW-MOVING VEHICLE safety legislation is now in effect in 14 states, the laws requiring or permitting use of a special triangular stick-on emblem to help prevent rear-end collisions between cars and vehicles that travel at slow speeds on streets and highways. Recent studies have shown there are about 12 million such vehicles and in an average year they are involved in about 8000 rear-end smackups.

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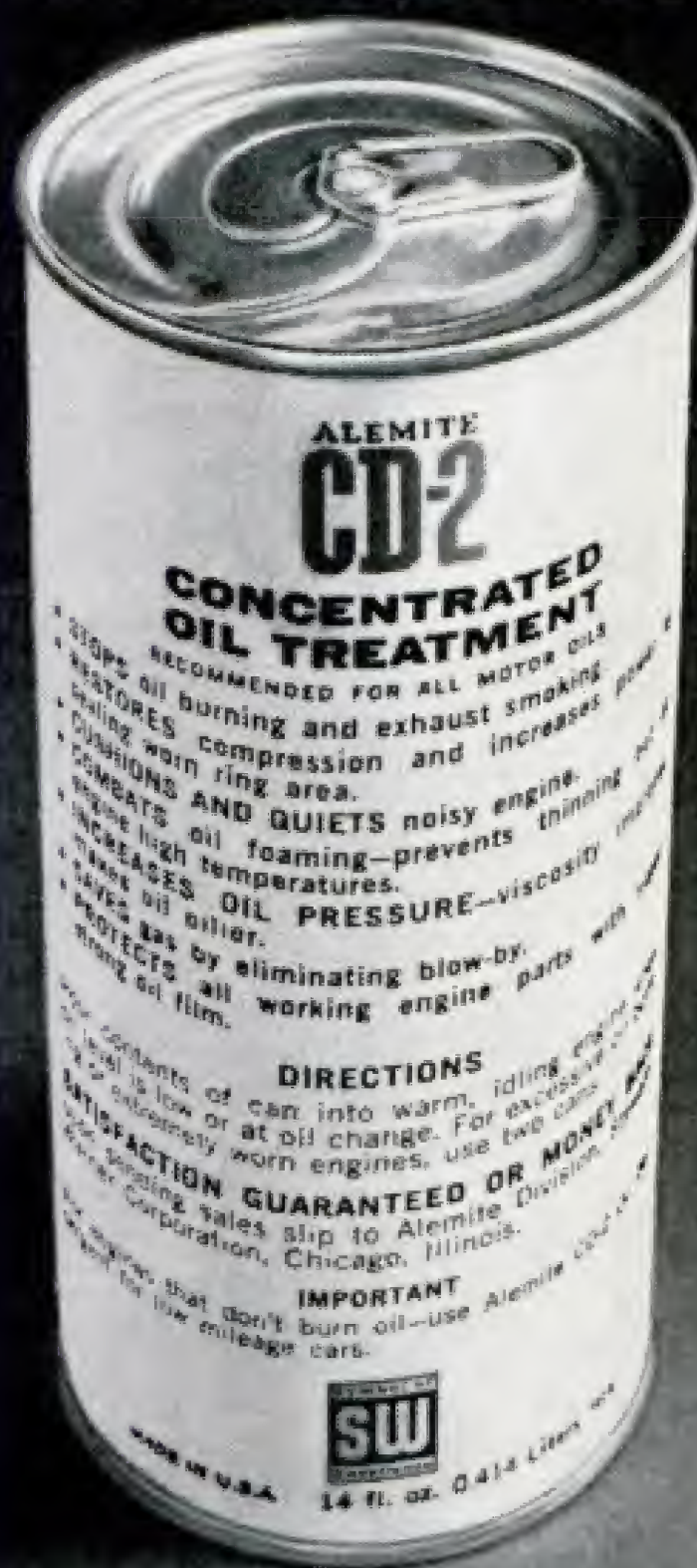
on the rear of vehicles that operate at speeds of 25 mph or less—farm tractors, construction machinery, highway maintenance equipment and so on. Use of the triangle follows a general trend among highway safety engineers to use the shape as an overall symbol for danger ahead.

The SMV (for Slow Moving Vehicle) emblem is mandatory in Rhode Island, North Dakota, Idaho and Montana; required in Ohio, Oregon, Indiana, Michigan, Minnesota and Nebraska; permitted in California, Iowa, Oklahoma and Vermont.

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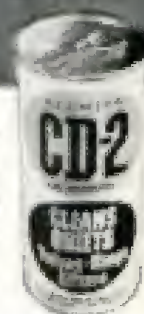
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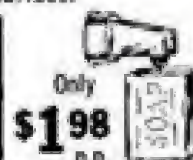
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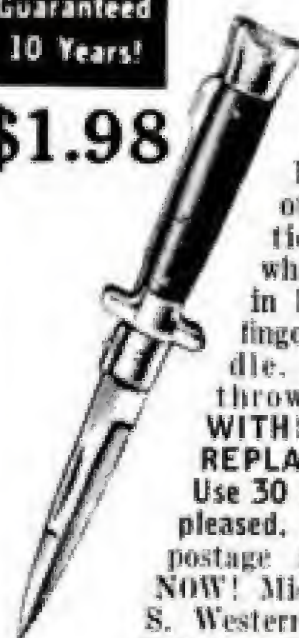
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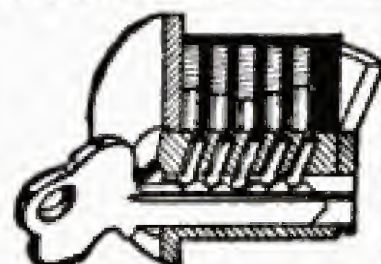
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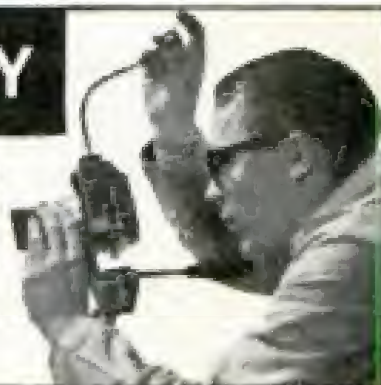
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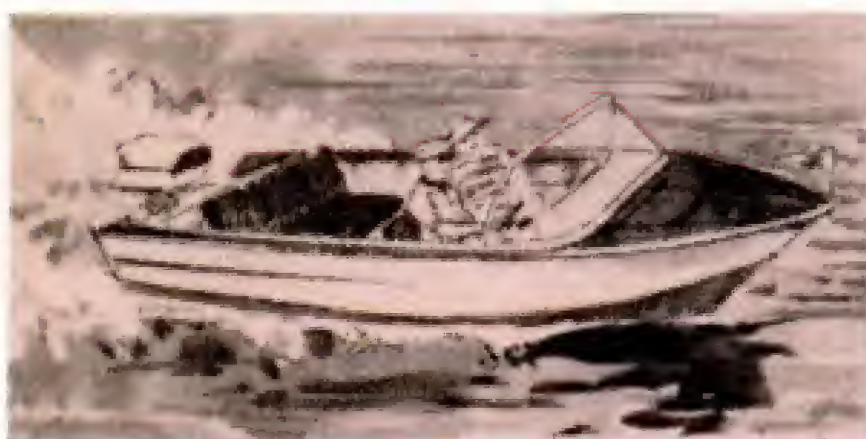
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WINDS OF 75 MPH will scare the sails off any boatman, unless he's a hardy English sailing aficionado. For the latter, such a wind is just one more trial to be reckoned with. This is true of K. Adlard Coles whose new book treats gales as though they were just another wind in true British understatement. Mr. Coles' book is titled *Heavy Weather Sailing* and is just that. For chapter after chapter he recites his experiences during gales encountered around the British Isles and during trans-Atlantic sailboat races. In rather droll terms—more scientific than salty—he explains how he sailed each boat during each gale. He explains what weather information he collected after the gale to substantiate wind velocity. And he gives a critique of what he learned.

It's these lessons in the storms that are fascinating. Many's the tip a sailor can glean from Mr. Coles' experiences. The book is almost textlike in its exactness. Too bad Mr. Coles isn't an adventure writer. If rephrased and re-emphasized, *Heavy Weather Sailing* could be an adventure in reading for sailors and landlubbers alike. Nevertheless, *Heavy Weather Sailing* is a good book—packed with valuable information—for the average weekend sailor who might once or twice find himself caught in a big storm. The book is published by John DeGraft of New York and sells for \$12.50.

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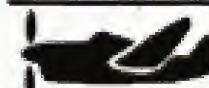
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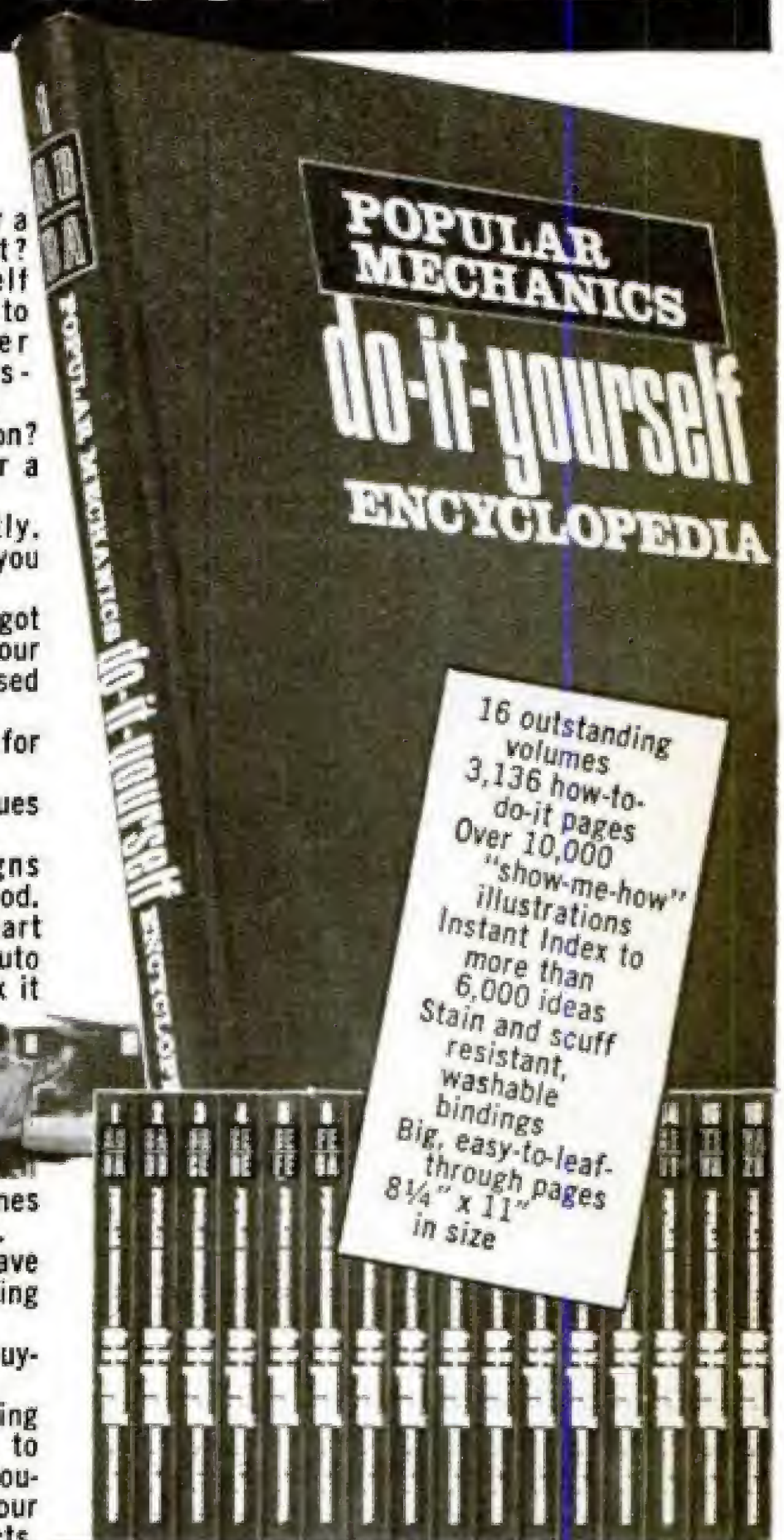
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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Transmission trouble

Because I was experiencing improper shifting of the Cruise-a-Matic transmission in my 1966 Mercury, I had the bands tightened, transmission fluid changed and modulator replaced. The mechanic said he found evidence of gasoline in the modulator. How does this happen and can I prevent a recurrence?
—Charles J. Dugan, Warminster, Pa.

Oddly enough, it is possible for gasoline to get into the transmission modulator. The modulator's vacuum line runs to the intake manifold. Fuel in a gaseous state can enter this line and condense to a liquid, then it can drip back to the modulator. To fix the problem, make a loop in the vacuum line between the manifold and the modulator.

Persistent rough idle

For some time, I've been experiencing a rough idle with my 1968 Dodge Dart GTS with 340-cu.-in. engine. Several tune-ups and a trouble diagnosis have failed to find the cause. Is there something about this car that we've overlooked?—Martin Meyer, Columbia, S.C.

There is the possibility of very slight rubbing between rocker arm and the edge of valve springs. This can result in a noise similar to tappet noise and/or rough idle. Inspect the rocker arms and valve springs. If one or more are rubbing, the top outer edge of the spring or retainer will have a shiny spot and there will be corresponding wear on the rocker arm. To correct the trouble, replace the affected rocker arm with part No. 3418425 (right bank) or with part No. 3418424 (left bank). There's a service bulletin covering this (D68-9-10, Jan. 22, 1969). Your dealer should make the change.

Hemming and hawing

The crankcase rear-bearing-shaft seal of my 1964 Chevrolet is leaking oil. A new seal, the installation of which involves dropping the pan, will cost about \$50. Would a can of one of the "stop leak" preparations soften up the seal enough to stop this leak?—Will Casey, Chattanooga, Tenn.

I doubt it. The seal has probably ruptured, and a "stop leak" solution won't put it back together again. However, every time I take a dogmatic view about one of these preparations, someone always writes to say how it worked for him. So, let me hedge. Try it. You have nothing to lose except a few cents. The preparation certainly won't harm anything.

Hot or cold

I had a rear-window defroster installed on my 1969 Buick Le Sabre. I get cold air out of it. What can I do to make it right?—Tony Stanich, Gig Harbor, Wash.

It is right, Tony. This is not a defroster in the same sense as your front windshield defroster. It's a defogger. The thing is only a fan that's designed to clear humidity-caused fog off the rear windshield.

Buzzing around

When I turn the key to start my 1963 Buick Special, I frequently get only a buzzing. It may happen one time or six before the engine catches and starts. I've cleaned and tightened the battery cables, and it hasn't helped. What's your opinion?
—Robert E. Partridge, Peoria, Ill.

There are only two things that cause this: (1) dirty or loose battery-cable terminals and posts; (2) a bad starter solenoid. I hope that when you cleaned the battery-cable terminals you took them off the posts and cleaned them thoroughly on the inside with a battery-cleaning tool. Make sure, too, that posts are sparkling clean and that there's a tight connection between terminals and posts. If the car still acts up, replace the starter solenoid.

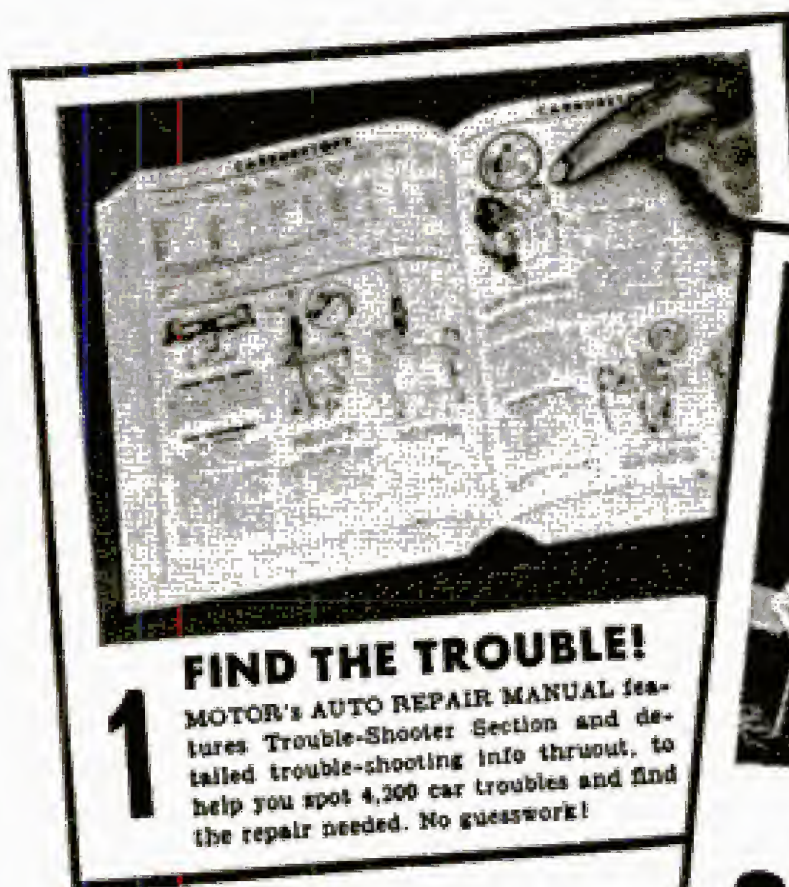
Trailer brakes

Are there any precautions to follow when connecting the hydraulic brakes of a travel trailer to a car or pickup having a dual brake system?—C.H. Proctor, Englewood, Colo.

Generally, you should tap the trailer brakes into the hydraulic line feeding the
(Please turn to page 68)

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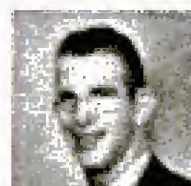
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AUTOMOBILE CLINIC

(Continued from page 66)

rear brakes of your car or pickup. This is a safety consideration. The subject of brakes is most vital for you fellows who tow trailers. I suggest that you contact a brake company that is interested in promoting safe trailering to get that company's recommendation. Kelsey Hayes in Romulus, Mich., for example, will send you information. Tell them the make and model of both vehicles.

Drowning Opel

My 1967 Opel Kadett is afraid of wet weather. Whenever it rains, the engine quits. Won't start—even stalls out dead cold if it's running along and suddenly the rain comes. Tune-ups haven't helped. Help!—Billy B. Booth, New Orleans, La.

The cure is a new kit at the Buick/Opel dealer which contains a new coil, relay and resistor wiring. The problem with your water-shy Opel is that there isn't enough insulation on the parts in the car to keep the ignition from drowning out. If you're still in warranty, the change will be free.

Leaky windshield

My 1967 Rambler Rebel is leaking like a sieve. Water's coming in on both the driver and passenger sides. I've had as much as an inch of water on the floor after 30 minutes of a fairly heavy rain, but I can't trace the source. Has this been a problem with the car?—Robert Goldsmith, Fort Myers, Fla.

It has. A poor sealing job around the front windshield on these Rebels has caused other guys just as much woe. I suggest you remove the molding around the glass and do a thorough resealing job using windshield sealer you can buy at an auto-body supply shop. Naturally, if the car's still under warranty, let Rambler do it.

Check the spec

It seems that I have excessive pedal travel in the power brake of my 1968 Pontiac LeMans. The dealer says no. Is he trying to duck something?—Robert Berry, Streator, Ill.

Pontiac uses an indentation in the floor pan to allow a lower pedal so you can apply the brake without lifting your foot. If you still have doubts, take a ruler and, without applying the brake, measure from the bottom back of the pedal to the highest spot on the floor directly beneath the pedal. There should be a clearance of 2½ in. If so, you've got no squawk. If not, something's wrong—like maybe they installed the wrong brake pedal at the factory. In any event, you now have proof positive to present to the dealer that he can't argue with. After all, that 2½-in. spec is Pontiac's—not yours.

Two cars—one problem

I own two '68 Plymouths—one Satellite; one VIP. They have one common problem. They vibrate and shake when I apply the brake at 40 mph and above. Why?—Arlo E. Hinkle, Pocono Summit, Pa.

Because the brake drums on these cars have become distorted. Take both cars back to the dealer and have him correct the condition by machining the drums. He'll follow the procedure in service bulletin 69-5-3. The date on it is 1/31/69.

SERVICE TIPS

● Chevrolet says it has a way to get rid of that oily film which is forming on the inside surfaces of windows. The haze is caused by volatilization of the solvents and plasticizing agents used in some of the synthetic materials put in cars. It smears when wiped and leaves a residue if you try to use a commercial glass cleaner. Instead, wipe the glass with a cloth soaked in vinegar. Then, wipe with a dry cloth. (My suggestion—not Chevy's—is that you then spray the inside of the car with a room deodorizer to get rid of that vinegar smell.)

● Chrysler-built cars with 383, 426 and 440-cu.-in. engines and manual transmissions now coming off the assembly line are getting new and better clutch-pressure plates than those installed in 1968 and early 1969 models. If your pressure plate suddenly goes poop, make sure the mechanic puts in this new one which has stronger eyebolts and lever pins. The part numbers are 3410182 (383 engine), 3410183 (426 engine) and 3410184 (440 engine). ★★★

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QUESTIONS ANSWERED
HOMEOWNERS'
BY W. CLYDE LAMMEY **CLINIC**

Mottled ceiling

I've just painted a plaster ceiling that was in bad shape. Though I had filled the digs and gouges with a prepared filler, or patcher, now it looks as bad as ever—every patch shows as a flat spot or streak through two rolled coats of paint. Any suggestions?—T.P., Ga.

What did you use as a "patcher"? Without knowing, I suppose that it must have absorbed the paint faster than the adjacent area did, thus creating the "flat" spots and streaks. There seems no simple solution, but perhaps all is not lost. I would attempt salvage by coating the flat spots with the same paint you used for the two top coats. Apply it with a small brush only to the areas affected and take care to brush it out to a smooth uniform film. After letting this dry thoroughly, roll on another coat slightly darker in tone.

Rusty saw table

I've just bought a used table saw and a wood lathe. Both saw table and lathe bed are of cast iron and very rusty all over the work surfaces. How can I clean them so that they will be usable? I'd like them shiny and smooth as they once were.—I.K., Ariz.

You can never achieve the shiny, smooth surface of the originals, unless you have them resurfaced on the same type of surfacer which did this originally. This would be expensive, of course. But you can remove most of the rust and get the saw table and lathe bed sufficiently smooth for practical use. Rent a portable belt sander from your local paint dealer or tool-rental shop, and buy one or two each of medium and fine-grade, aluminum-oxide belts, also one or two each of the same grades for hand abrading as a preparatory step. Attach a strip of the medium grade to a block of wood and remove the worst of the rust and discoloration by hand, using the two grades of abrasive alternately. Then, using a medium-grade abrasive belt on the sander, run slightly overlapping strokes from side to side of the saw table, being sure the strokes are straight. When the rust has been removed, change to the fine

belt and repeat until you have a reasonably smooth, bright surface. Proceed much the same with the lathe bed, after removing the head and tailstocks and the tool-rest. Then coat the renovated surfaces with paste wax and polish with a soft, lintless cloth.

Condensation on floor


We're going to build a small home on a concrete slab floor. Several neighbors with similar homes have warned of the trouble they've had with sweating floors, especially around the outside walls. We want to avoid this. What is the cause, and is it preventable?—W.H., Minn.

Put simply, the cause usually is a variation in temperature between that of the floor at the periphery of the structure and air in the rooms. Slab floors poured improperly or tiny hairline cracks in the concrete also invite trouble by permitting moisture to migrate from underneath to the top side. This is especially true of slabs poured directly over earth rather than screened gravel or crushed-stone beds properly tamped. The best construction generally requires that the site be graded to provide adequate drainage away from the walls and that the slab be poured over a tamped gravel or crushed-stone bed; that the concrete slab be wire-reinforced; that there be a suitable vapor barrier over the top surface and on top of this a foam-plastic insulation—minimum thickness 1 in.—over the whole. This is then topped with ½-in. (minimum thickness) tongue-and-groove plywood over which wall-to-wall carpeting or tile may be laid. You can get more detailed information from your local building materials dealer or your state university extension service. Contact them directly.

Self-finishing wood

I used new redwood paneling in my basement recreation room on the advice of a friend. He says it will not be damaged by water should my basement flood due to water backing from the storm sewer. How can I preserve it as is?—D.N., Ohio.

It can be left without any finish at all—redwood might be called a "self-finishing" wood. In time it will mellow to a somewhat deeper reddish-brown with some variation between the light and dark tones. Should the basement flood, the wood will not be harmed noticeably provided the water drains within a relatively short time and paneling was applied according to accepted practice. ★ ★ ★



HELP!

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Whenever you want to hold, cut, strip, drive, grip, bend, pull, twist, straighten, tighten or loosen . . . man, you need help! The kind of help that not only gets the job done faster *now* but year after year as well. The kind of help you get only from hand tools by Channellock. Doubt it? Take hold of a Channellock tool.

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We brew every bottle of Miller High Life as if it were the only one



Miller
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The Champagne of Bottle Beer

Next Month in Popular Mechanics

Owners Reports on the Plymouth Valiant and Jeep Wagoneer

After driving more than a million miles in a car they bought for economy, Valiant owners report they are getting what they want: economy. But they complain mildly about workmanship. Jeep Wagoneer owners, who bought because they want four-wheel drive, are happy using that feature for hunting, fishing and camping. But they're complaining about mileage.

What's the Truth About Speed Laws?

You pay a fine, the other guy gets off. How come? There are times when courts *don't* agree with the man in blue, and it helps to know when those signs mean what they say.

How to Buy a GOOD Old House

An old house can be a bargain if it's sound—and a nightmare if it isn't. In September, an expert tells you what to watch out for and how much repairs may cost.

10 Clues for Finding Hidden Ignition Troubles

Next month *Saturday Mechanic* describes some overlooked sources of ignition trouble and what you can do to fix them.

Packaged Fence Panels Offer Both Beauty and Privacy

You can choose from a wide variety of attractive enclosures if you play "musical chairs" with these new interlocking, pre-painted aluminum panels.

Look What's Happened to Bows and Arrows

Archery's exciting new look is the result of computer design and the use of new materials. Now you can be an expert archer in no time flat.

The World's Sharpest Tool

They'll never make it to Tiffany's, but industrial diamonds can cut, grind and grip like nothing else on earth.

Antisubmarine Warfare

Russia's 50 nuclear subs spell trouble for the U.S. Navy's ASW forces. But amazing new weapons are making the "nukes" easier to track and destroy.

The ABCs of Chassis Frames and Suspensions

The manner in which four simple wheels are attached to a platform to shape the undercarriage of your automobile has infinite variations and determines how your car rides and handles.

Big Ambulance for Big Birds

When a jetliner makes a belly landing, the blocked runway can cause traffic diversions that may cost up to \$175,000 per hour. Now a Californian has a huge retrieval rig that will clear the runway with no further damage to the airplane.



It's a banner year for Number One.

Pure Firebird® Racing Gasoline is winning more races, setting more records, than all the other brands combined this year. Like any other year. That's why Pure is the Number One choice of the men who race . . . and why Pure knows how to make a powerful gasoline for you. It's called Pure Firebird Super—from the Number One name in racing.



UNI 76 N

Pure Oil Division



Maverick Versus The Mob

Ford says its new subcompact's main target is the economy imports. Could be, but after our side-by-side comparison tests, we doubt if they'll drop dead.

By BILL KILPATRICK, Auto Editor

THERE'S A STORY going around—it might even be true—that Henry Ford personally turned thumbs down on certain of the advertising gimmicks and slogans his troops dreamed up to launch the Maverick. One rumored reject was a takeoff on the old movie cartoon signature, the twist being, "Th-th-that's all, Volks."

If the story is true, Mr. Ford is a per-



STACKED UP against Ford's \$1995 Maverick for the test are, from top to bottom, the \$1799 Volkswagen 1500 Beetle, the Renault R-10 four-door sedan at \$1775 and the \$2135 Toyota Corona two-door hardtop



CORONA interior is smart. It's the only car to offer both 2 and 4-door models



MAVERICK interior features sweeping dash, wide bench, cornball upholstery



VOLKSWAGEN interior is austere, but functional; workmanship is impressive



RENAULT interior is most comfortable; ignition key on the left is annoying

ceptive man, a realist who appreciates that verbal gymnastics won't make Volkswagen or any of the other established economy imports go away. VW, Opel, Toyota, Datsun, Fiat, Renault, Austin, Simca et al are hard-nosed facts on today's U.S. automotive scene, their sales accounting for some 60 percent of the so-called "small car" market. For Detroit to make significant inroads therein will take more than so-so puns.

Happily, despite the imperial thumb apparently being turned up to such precious nonsense as paint jobs called "Thanks Vermillion," "Freudian Gilt" and so on, the Maverick is real substance behind a shadow. It could—indeed does—stand by itself as a car capable of making it on its own. But the American appetite for drama, or competition, or whatever, seems to demand that we have good guys and bad guys. Thus the public fancy, abetted by a lot of nervous advertising, tends to compare the car with the economy imports.

More accurately and meaningfully, the Maverick should be compared with, say, the Rambler or the Valiant. All are American in style, execution, "feel." But Ford (the company and—seemingly—the man) seems to feel its hay is to be made in wooing buyers away from the imports. Can the Maverick accomplish that difficult task? The answer has to be double-edged.

The first part of the answer has to do with hardware—what you get for your money, how much car, how much performance, and so on. The second part has to do with a sort of auto marketing Never-Never Land—the psychological fulfillment a buyer gets from owning and driving a certain type or make of car. First things first.

For our tests we picked the VW "Beetle" because Ford has zeroed in on it as Maverick's No. 1 "enemy," the Toyota Corona because we thought of it as being the zippiest of the economy imports, thus most likely to approach the more powerful Maverick in performance, and the

WINNING STYLE is captured as Maverick starts fastest 0-60 run





IN THE PITS at Pocono Raceway, the Maverick is readied for its acceleration and fuel economy runs

Renault R-10 because it offers certain creature comforts (marvelous seats, for example) lacking in the others. East Coast port-of-entry prices are \$1799 for the VW, \$2135 for the Corona hardtop (\$1950 for four-door sedan), \$1775 for the Renault. The basic Maverick (which our test car was) is pegged at \$1995. All cars were "as is," and all had manual transmissions. Specifics:

VOLKSWAGEN 1500 2-DOOR SEDAN

Engine: Horizontally-opposed air-cooled

4-cyl. in rear, 91.1-cu.-in. displacement, 53 hp @ 4200 rpm

Gearbox: 4-speed all synchromesh

Brake type (front/rear): drum/drum

Dimensions: 158.6 long, 61 wide, 59.1 high, 94.5 wheelbase, 1808 weight

TOYOTA CORONA 2-DOOR HARDTOP

Engine: In-line 4, 115.8-cu.-in. displacement, 90 hp @ 4600 rpm

Gearbox: 4-speed all synchromesh

Brake type (front/rear): drum/drum

Dimensions: 162.4 long, 61.6 wide, 54.1 high, 95.3 wheelbase, 2260 weight

RENAULT R-10 4-DOOR SEDAN

Engine: In-line 4 in rear, 67.6-cu.-in. displacement, 48 hp @ 4600 rpm

Gearbox: 4-speed all synchromesh

Brake type (front/rear): disc/disc

Dimensions: 167.5 long, 60 wide, 55.5 high, 89 wheelbase, 1825 weight

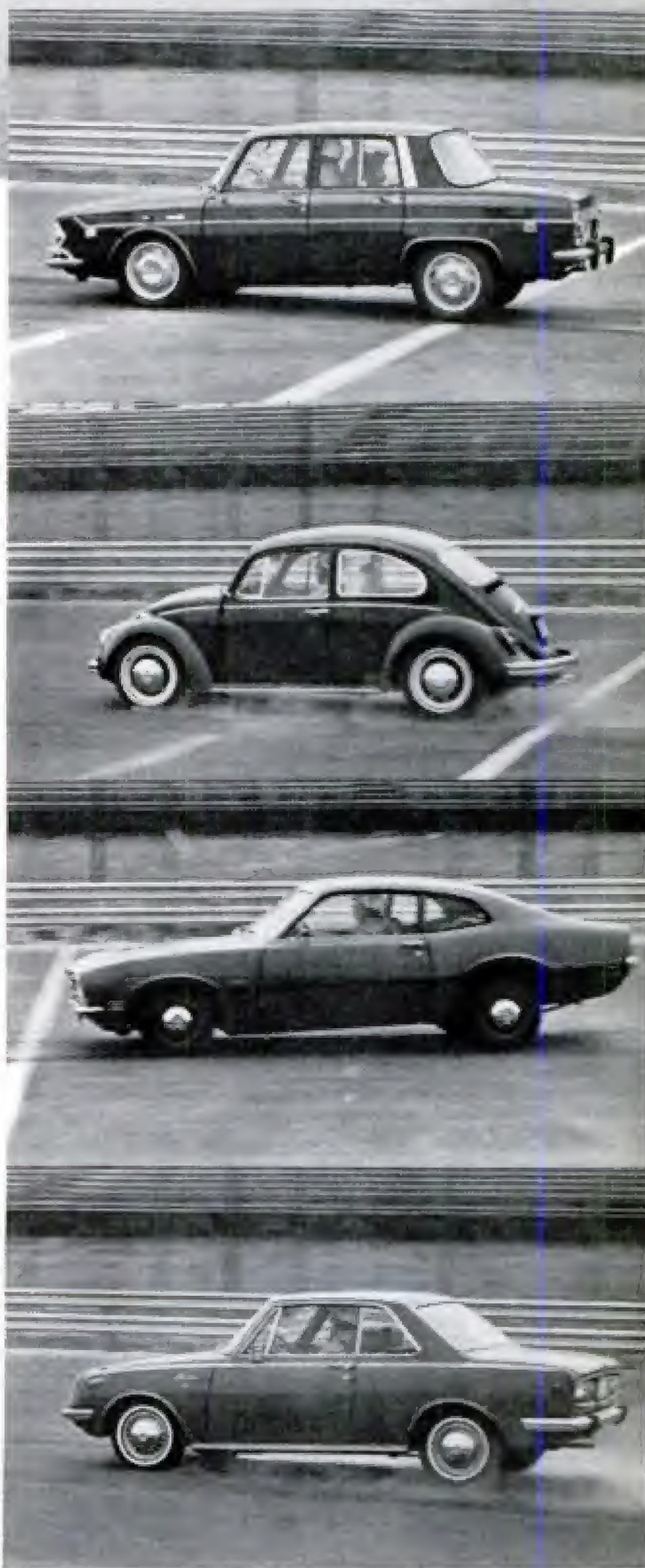
FORD MAVERICK 2-DOOR SEDAN

Engine: In-line 6, 170-cu.-in. displacement, 105 hp @ 4200 rpm

Gearbox: 3-speed all synchromesh

Brake type (front/rear): drum/drum

Dimensions: 179.4 long, 70.6 wide, 52.3 high, 103 wheelbase, 2501 weight



BRAKING TESTS had Renault with its four-wheel discs hauling down fast and straight; VW and Maverick had good controlled stops; Toyota got persnickety

We tested the cars at Pocono In-
AUGUST 1969

Photos by Stanley Rosenthal

PERFORMANCE AND ECONOMY—HOW THEY COMPARE

	ACCELERATION 0-60 MPH (Sec.)								MPG RANGE (Normal Driving)								
MAVERICK																	
RENAULT																	
TOYOTA																	
VW																	
	14	16	18	20	22	24	26	28	20	22	24	26	28	30	32	34	36

ternational Raceway, a still-building racing complex in the mini-mountains of Eastern Pennsylvania. But getting there from New York, our test crew had an opportunity to drive each of the cars over a variety of surfaces in traffic, on open highways, and up and down some tricky, narrow roads. Thus our overall impressions covered a reasonably broad fair-weather spectrum of driving conditions.

The first test at the Raceway—using our “fifth wheel”—was for out-and-out acceleration. We had one driver take four timed runs, two in each direction to allow for the wind. The VW went from 0-60 mph in an average of 24.5 seconds, the Toyota in 18 flat, the Renault in 22.5, the Maverick in 15 flat. To get from 40-60 mph in high gear—the thought being to simulate a typical passing situation, again four runs, two in each direction—took the VW 22 seconds flat, the Toyota 13.1,

the Renault 22 and the Maverick 14.2.

Looking at the results, the conclusion would have to be that the Maverick gets off the dime quicker than the others, but that the Toyota has the best mid-range pickup.

Next we looked into the tricky business of miles-per-gallon economy. We say “tricky” because—while absolutes can be measured—mpg is subject to so many variables that coming up with a single figure is often inconclusive. Take the wind, for example; it can be steady in a given direction for one car, and, a few minutes later, gusty and erratic for another. So the best bet, we feel, is to report a *range* of mpg, as shown in the accompanying chart.

Another tricky thing to measure is braking. A so-called “panic stop,” for example, when brakes are slammed on at, say, 60 mph and the wheels lock and the car skids to a halt, is as much a test of tire “stickiness” as it is of anything else. All things being equal, the tread on Brand X may stick a bit better than the tread on Brand Y. So here again we give a *subjective* report of our braking test results.

From 60 mph, we did four panic stops with each car and four “controlled” stops (i. e., bringing the car to a halt without locking the wheels). In both tests, the Renault stopped in the shortest distance with the least variance from a straight line. Close in stopping distance and only slightly off-line was the VW. The Toyota proved a bit of an adventure; we stopped in a



EDITORS KILPATRICK AND HARTFORD suit up in the Maverick; timing gear and meters are between them

reasonable distance, but we sashayed over a good bit of road in the process. The Maverick hauled down fine (albeit, over a greater distance, which figures because of its heavier weight) in the controlled stops, but the rear end bounced like a rubber ball in the panic stops, the result being—again—sashaying over a lot of road.

The rest of our four-car “shoot-out” consisted pretty much of personal opinion. We all liked the Maverick’s room, the Renault’s seating comfort, the Toyota’s pep, the VW’s workmanship. But after agreeing on these points, opinion became fragmented. For example, I didn’t particularly mind the VW’s noise, but Alex Markovich did. Bill Hartford was almost indignant about having to really slam the Maverick’s doors to get them shut tightly, but to me that’s almost Detroit standard operating procedure. Bill didn’t mind hard cornering in the VW, but Alex and I think it’s an adventure. We all found ourselves apprehensive about taking tight bends in the Renault, yet none of us actually felt we were ever in trouble. Body lean was greater in the Toyota, but again not to the point of making one prematurely gray.

Bill would like to see a four-speed floor-mounted stick in the Maverick. Agreed. While I found the R-10 the most comfortable of the four cars, I don’t much care for the idea of having the steering wheel and foot-control pedals off-center to the right; it just doesn’t *feel* right. Speaking of “feel,” I thought the Toyota felt best, was more a part of me than any of the others. Bill liked the VW for the same reason. Alex thought the VW’s speedometer redlines for each gear were far too conservative, that each must be exceeded by as much as 50 percent for decent, safe acceleration (and without harming the engine). When it comes to shifting, I tend to “drive by ear,” never mind the redlines.

We could go on, feature by feature, but what we’d be doing is more or less answering both parts of that double-edged question we asked before: Can the Maverick woo buyers away from the imports?

To answer the first part—head-to-head comparison—assuming the slight price dif-

(Please turn to page 196)



MAVERICK goes in hard; controls retain feel



RENAULT comes out of turn with minimum roll



TOYOTA has the most body roll but is stable



VOLKSWAGEN goes through with some oversteer

How They Keep Without Getting



Old-fashioned test methods often wrecked the very thing they were supposed to protect. Now a fascinating science called Nondestructive Testing checks out bridges, buildings, wings on airplanes, even candy bars—without touching them at all

THEY USED TO TEST airplane wings by piling sandbags on them. A wing that held was considered safe. If, later, it dropped off in flight, everyone was surprised. How could it? Normal stress in flight was much less than the thousands of pounds of sandbags used in the test. That a wing could support a tremendous load for a brief period but not necessarily over and over again, day in and day out, was never considered.

This was typical of early testing methods that consisted mainly of seeing if a thing would break by trying to break it or by running a piece of machinery until it almost fell apart. The

assumption was that if a mechanism worked perfectly 1000 times in a row without a miss, it would continue to work indefinitely. But sometimes it failed on the thousand-and-first try.

Often, overtesting a delicate mechanism might cause it to fail sooner than if it hadn't been tested at all. Some of our early space rockets that exploded in flight or never got off the launch pad were found to have been tested to death. The parts had all been so carefully tried over and over again before the flight that, by the time of actual countdown, they were simply worn out.

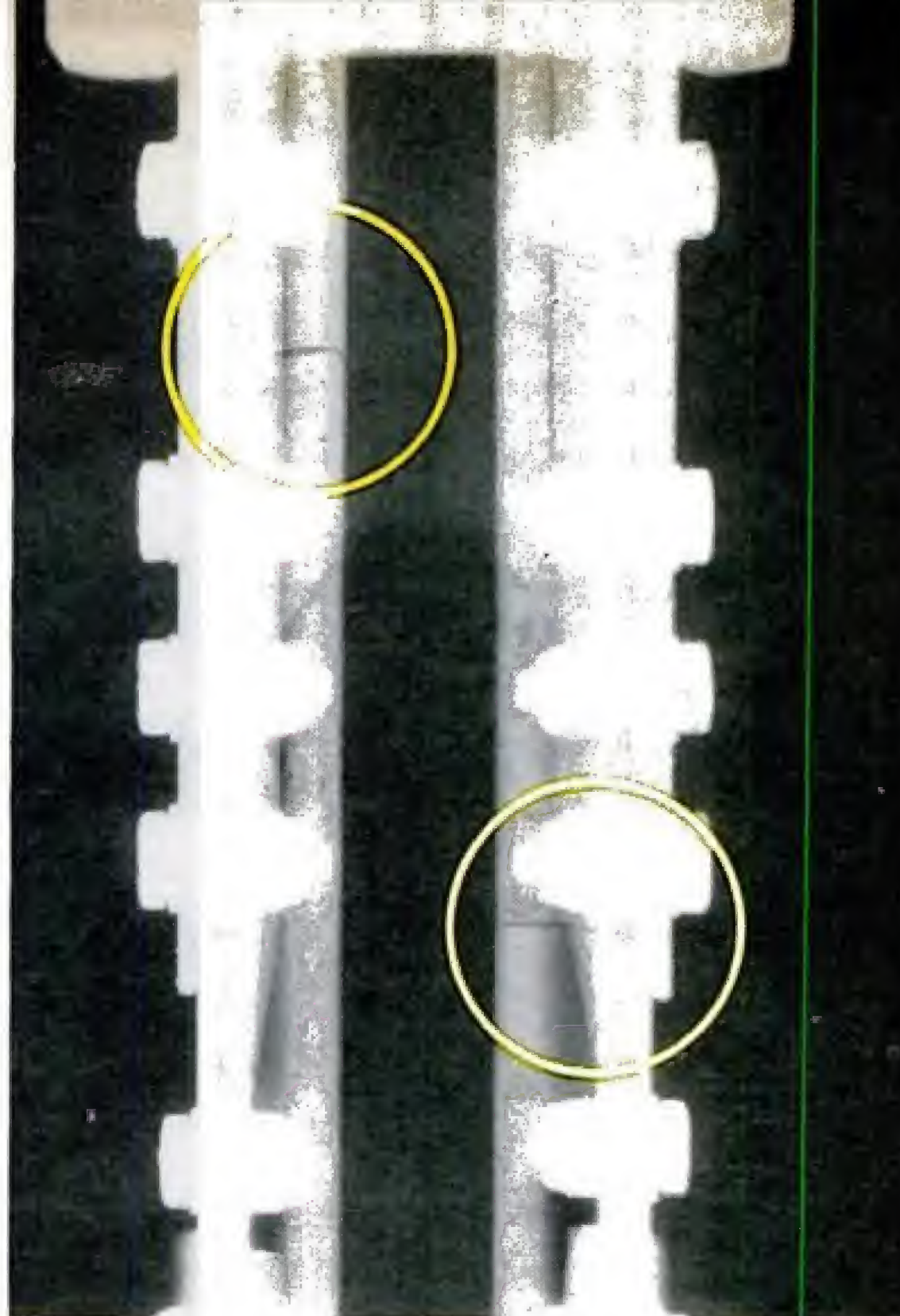
Today, your life depends—literally—on a spectacular new space-age tech-

You Safe— You Killed

By ARTHUR S. FREESE



SWARMING OVER THE WING of an Eastern Airlines Electra turboprop, eight inspectors simultaneously check for hidden flaws inside the honeycomb structure



using ultrasonic test instruments. At right, a radio-graph reveals dangerous hairline cracks (circled in color) in the wing spar of another airliner



SMASHED CARS AND TRUCKS lie in the twisted wreckage of the Silver Bridge, which collapsed shortly before Christmas in 1967, killing 46. Spanning the Ohio River near Point Pleasant, W. Va., the structure is believed to have failed because a connecting pin gave way. One of these pins, joining several bridge links, can be seen in the foreground at right. Modern testing methods using NDT principles make a repetition of such a disaster unlikely



EVEN TENNIS RACKETS are tested by modern NDT methods. This one-piece magnesium-alloy Centurion is first checked for surface flaws with fluorescent

dye (center). Frame is then X-rayed to spot deeper defects that might weaken it (right). This permits racket to be made lighter with no loss of strength

nology called Nondestructive Testing—testing without destroying the object being examined. Called NDT for short, it makes it safer to drive a car, fly a plane, ride in a train, heat your home, or eat a piece of candy.

You can't test an elevator by running it until the cables are worn out or check a bridge by jumping up and down on it. NDT makes sure that such structures are sound without endanger-

ing your life in the process.

The need for safe, foolproof test methods was dramatically demonstrated by the tragic collapse in December, 1967, of the Silver Bridge over the Ohio River near Point Pleasant, W. Va. Jammed with homeward-bound commuters and holiday shoppers on a Friday night shortly before Christmas, the span crashed without warning into the black and icy waters below, carry-

OPEN WIDE: One of the largest X-rays ever made shows an entire jet engine in cross section. To make such X-rays without dismantling the engine, a radioactive probe is inserted in the jet's throat

ENLARGED X-RAYS of a toggle switch help Cutler-Hammer engineers design foolproof controls for space exploration. Taking such a switch apart to see inside it often destroys the results of a test





NEW WELDED BRIDGES are constantly checked with penetrating dyes for sound joints. A tell-tale dye streak (right) indicates cracked weld



A GIANT VALVE for a high-pressure pipeline is X-rayed in same way as a dentist X-rays your teeth. Defects appear as dark spots on film—just like cavities

ing 46 to their deaths and injuring scores of others.

Relatively young as bridges go, the 40-year-old structure used an unusual link-suspension design in which bars were joined at their ends by steel cross pins. While the official verdict has not yet been made public, it is widely believed that one of the pins gave way, throwing abnormal stresses on surrounding pins. One by one, the others snapped in rapid-fire succession—like a row of tumbling dominoes—plunging the bridge into the water.

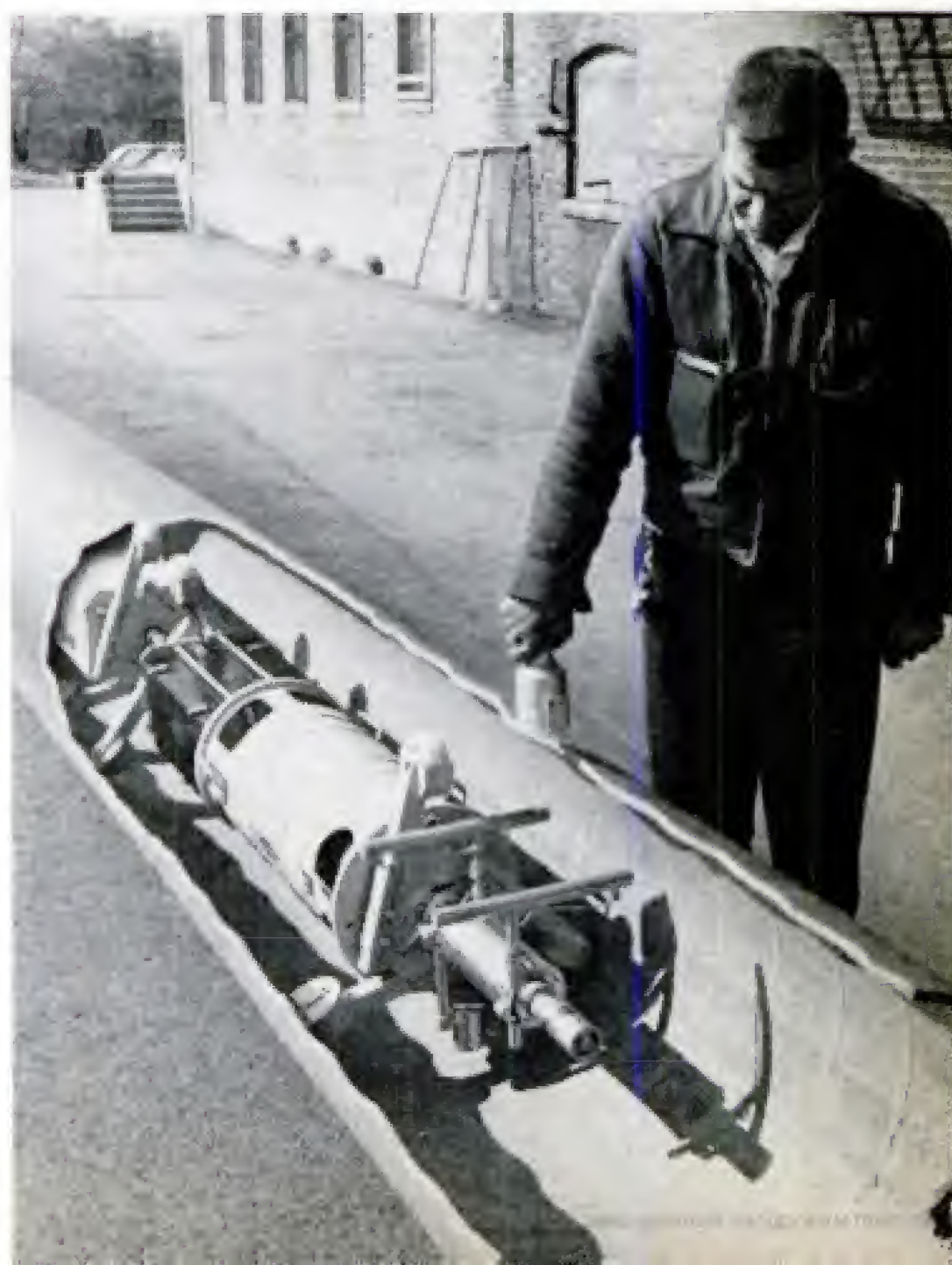
Today, engineers know that metals get tired, just like people, and that the ravages of rust, corrosion, wracking winds and relentless vibrations can topple the mightiest of structures unless they're carefully and periodically checked. Now NDT experts can "look inside" an airplane wing or bridge girder and spot the tiniest flaw—sometimes only the hint of abnormal stress or wear—long before it becomes a major disaster. These exotic techniques include the use of X-rays, holography, liquid crystals, ultrasonics, dye penetrants and magnetic fields. Like a doc-

(Please turn to page 188)

MOUNTED ON WHEELS, the unusual self-propelled X-ray machine at right crawls through miles of pipeline to check welded joints from the inside. The Picker Corp. device is powered by batteries, travels 39 feet a minute, can even go up and down hills



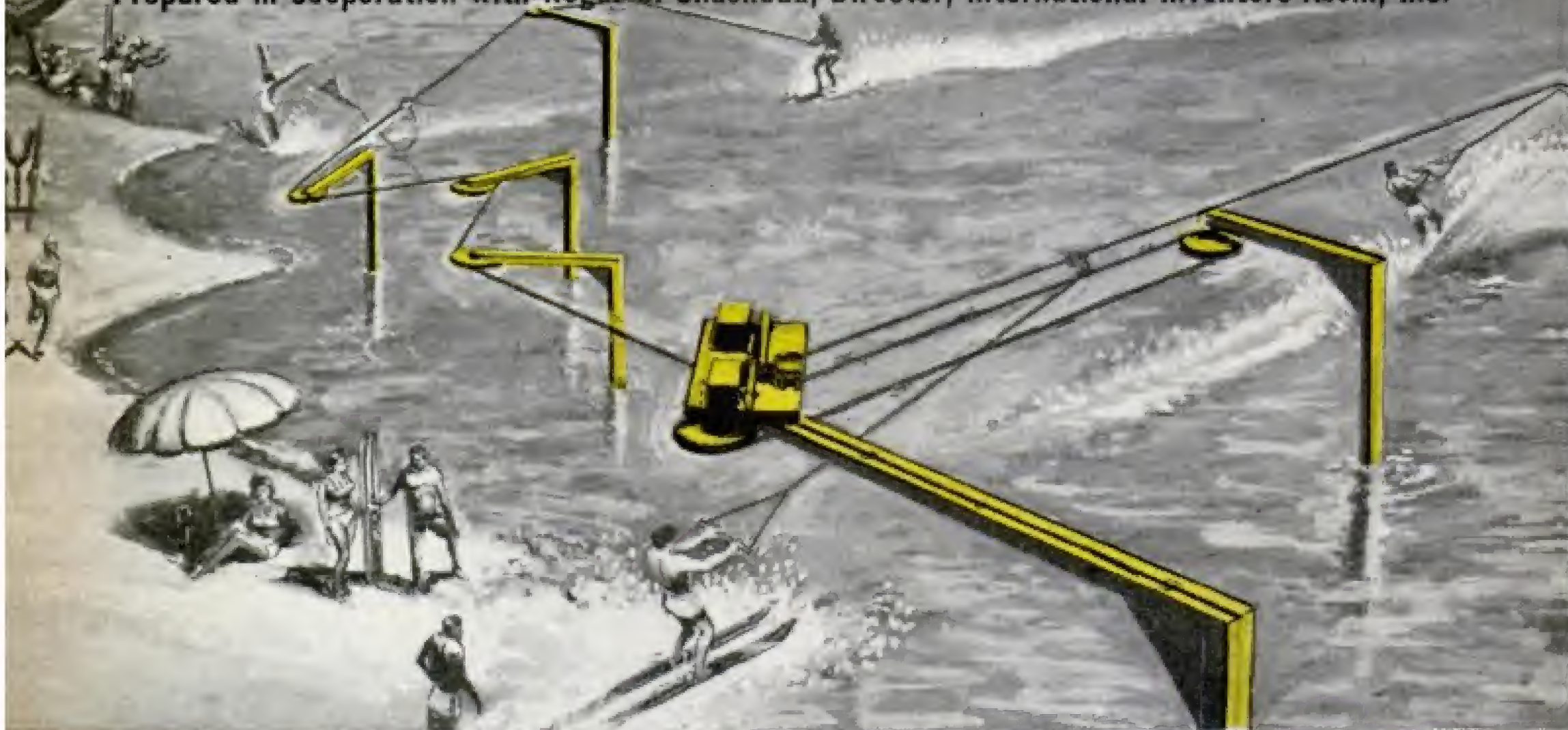
STRAIN LINES show up dramatically in Bell Labs' hologram of metal pulled apart 50/1000ths of an inch



Just patented

PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.

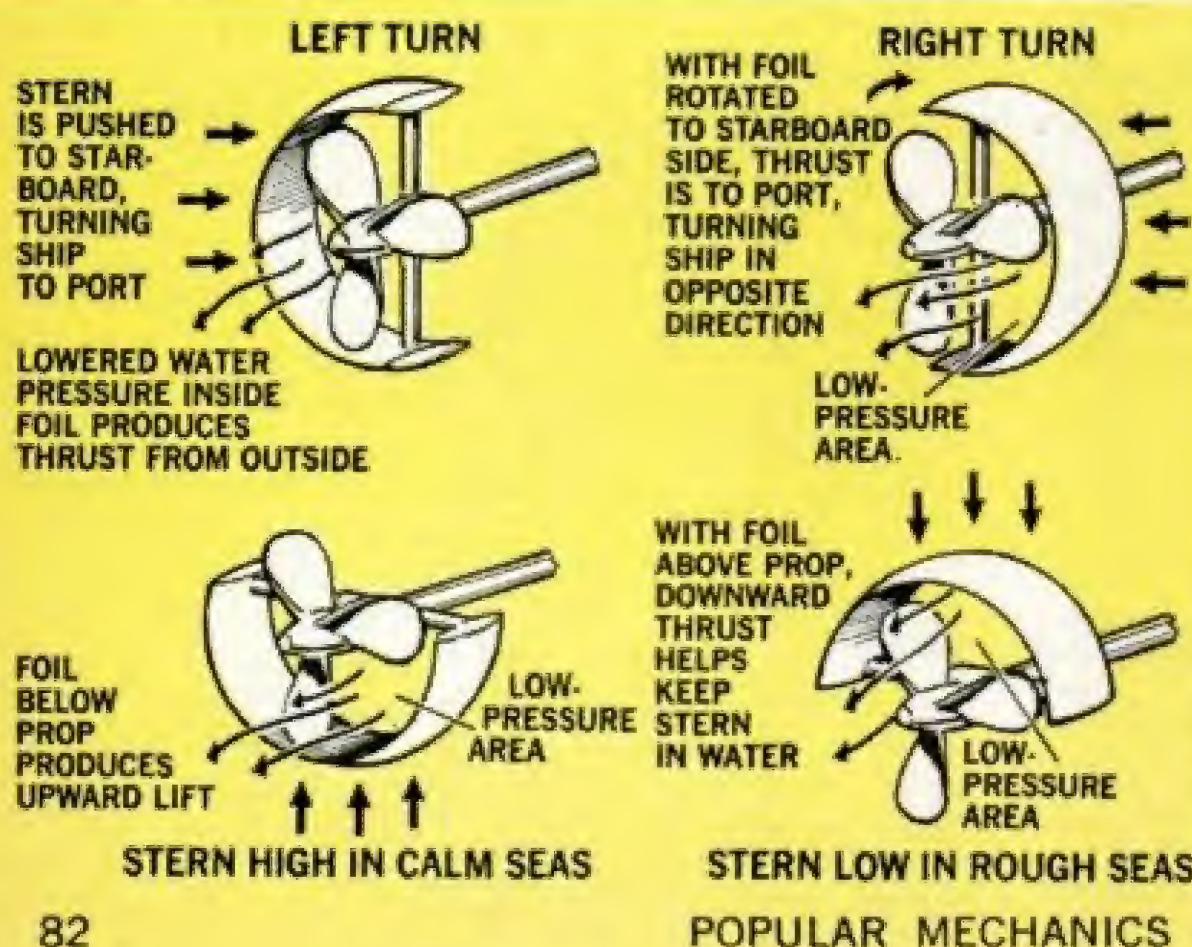


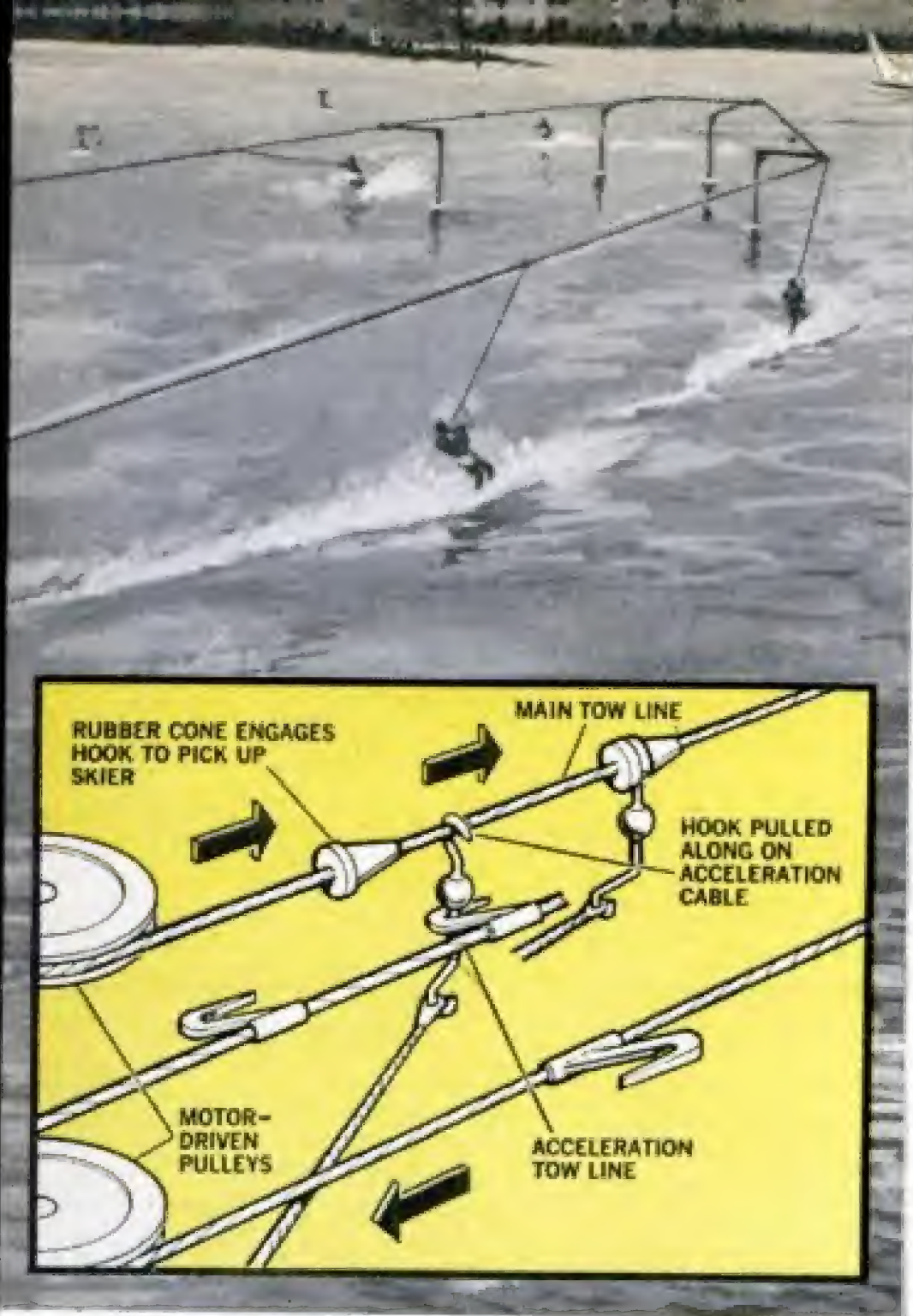
1. YOU DON'T NEED A BOAT to go water skiing with this ingenious towing device. A motor-driven cable supported by pulleys on poles pulls skiers around a course about the size of a football field. To hook on, a skier starts out on a special acceleration towline that gradually brings him up to

the speed of the main tow cable. As his speed increases, a cone-shaped rubber stop on the cable, traveling slightly faster than the acceleration line, picks off the hook, transferring the skier to the main towline. At the end of the run, the skier lets go of his towrope and skis onto the beach

2. UNUSUAL RUDDER FOR SHIPS does more than just steer. It consists of a half-ring that can be rotated around the propeller. The half-ring has a foil shape like an airplane wing and works in the same way. Water driven by the prop rushes past the inner surface much faster than water on the outside. This creates a low-pressure area on the inside, and the higher outside pressure forces the

rudder sideways—to the right when it's turned to the left and vice versa. This steers the ship without the drag of a conventional rudder. The same effect is also used in two other ways. In the bottom position, the rudder exerts an upward thrust that lifts the stern and increases speed in good weather. In the top position, it forces the stern downward, thus helping to reduce pitching in rough seas



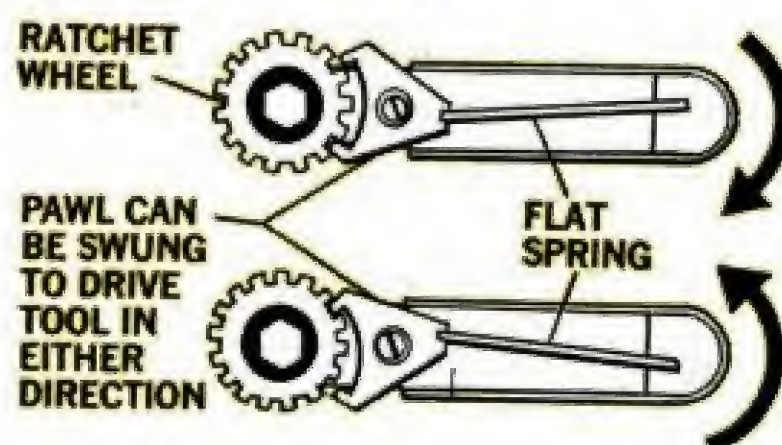


3. ROCKING CRADLE FOR CARS is designed to eliminate the need for expensive hydraulic lifts when making underneath repairs. You drive up a ramp onto two tracks, then roll the car sideways on two large rocker-like supports at the ends. At the desired tilt, the cradle is locked rigid by chains and braces. The arrangement provides enough clearance for most types of underbody repair work



Inventors of the items shown on these pages are as follows: 1. John T. Hancock, 8750 W. Dakota Ave., Denver, Colo.; 2. Lt. Peter T. Tarpgaard and Lt. Samuel J. Gordon, Massachusetts Institute of Technology, Cambridge, Mass.; 3. Licencia Oy, Ltd., P.O. Box 14170, Helsinki, Finland;

AUGUST 1969



4. RATCHET-ACTION SCREWDRIVER above makes it easy to drive screws in tough materials and hard-to-reach places. You just flip the side lever back and forth and a pawl engages a ratchet to turn the screwdriver blade. Reversing the pawl lets you remove screws as well. Slip out the screwdriver and you can insert other accessories such as drill bits and nut drivers

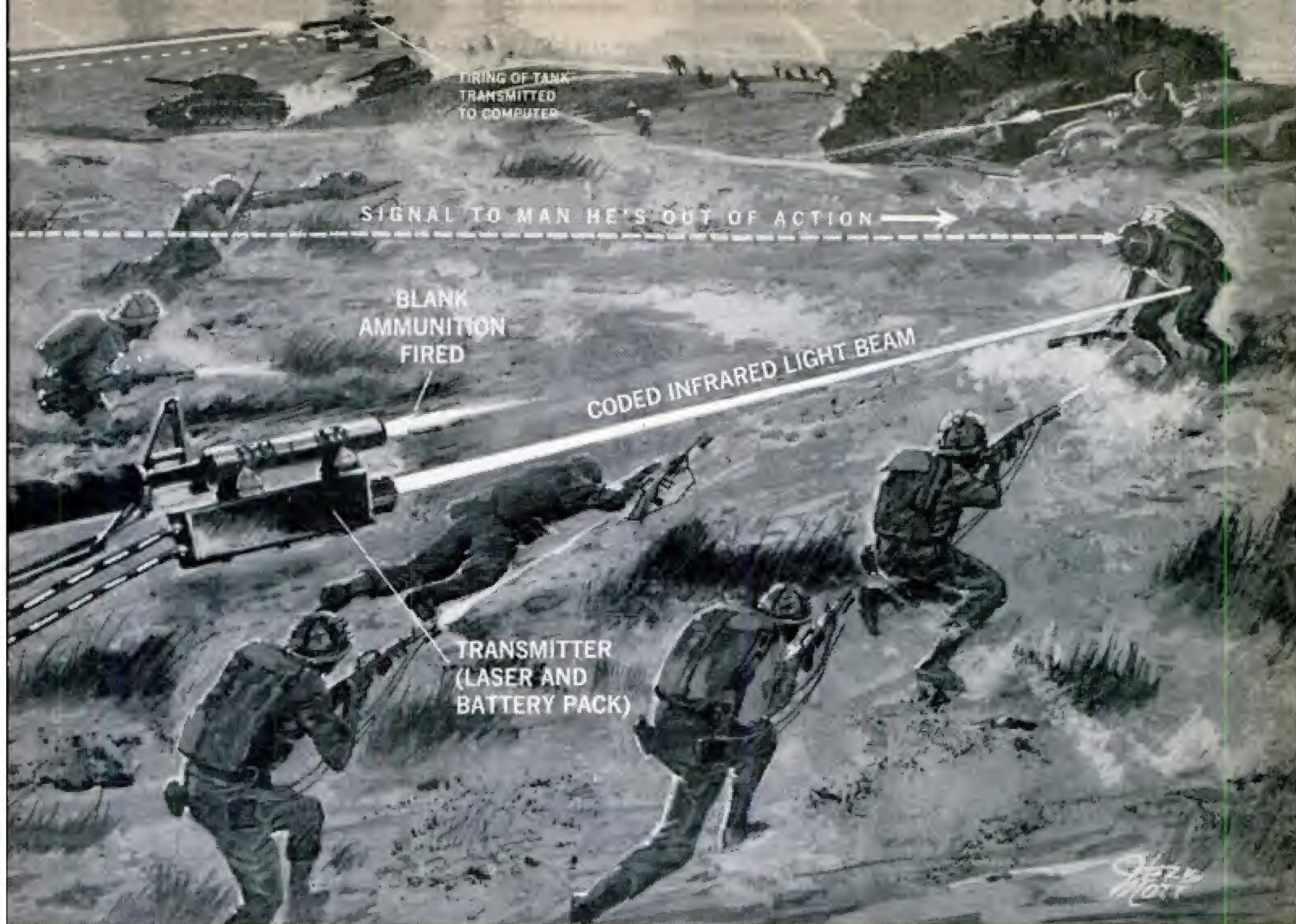
5. YOUR COAT CAN'T BE STOLEN off the coat rack shown below. As you hang it up, you draw a chain through each sleeve. The ends of the chains, fitted with metal balls, are dropped into the metal container, along with your hat, gloves and other small possessions. When the lid is closed and locked, the balls prevent the chains from being pulled out, thus making it impossible to remove the coat



4. James T. and Manuel Vosbikian, Hardware & Industrial Tool Co., 20th and Oxford Sts., Philadelphia, Pa.; 5. Gilbert Borel, Le Cachot, Switzerland. Roger Shashoua can be reached at the International Inventors Assn., Inc., 680 Fifth Ave., New York, N. Y. 10019.



REALISTIC COMBAT TRAINING is now possible with rifle and tank-mounted infrared light beam transmitters. Men and equipment are automatically signaled when they have been hit. A mobile computer eliminates the need for umpires to arbitrate disagreements, determine the "kills" and the outcome of the battle



They've Taken the Guesswork Out of War Games

Infantrymen drop in their tracks when hit, tanks go up in smoke, and a computer keeps score of the battle. It's as real as war—but nobody is killed

By MORT SCHULTZ/ Illustration by Herb Mott

AN INVISIBLE BEAM OF LIGHT is helping save the lives of American soldiers by taking the "mock" out of mock battles.

Although produced by a single laser diode that's no bigger than a grain of pepper, the light can, when necessary, be cast 3000 meters. That's almost two miles.

During maneuvers, it allows a soldier to aim and fire his M16 rifle at another GI and see him fall to the ground. It permits a U. S. tank to fire its giant gun at another U. S. tank and have it go up in smoke.

In time, the infrared light beam will allow two jets to engage in a no-holds-barred dogfight, permit ground-to-air missiles to knock planes from the sky, and let helicopters and other aircraft strafe installations.

If at this point you're starting to confuse maneuvers with combat, you have the idea behind development of the direct-fire simulator of which this laser light beam



INFANTRYMAN ON MANEUVERS has two-pound laser transmitter, four detectors on helmet, four on his body

is the key element. It makes war games so much like combat that it's frightening if you let your imagination get out of hand.

Anyone who ever took part in maneuvers can appreciate the importance of this development to a young GI who's training for combat. No longer do war games resemble a game of cops and robbers.

Imagine yourself for a minute on maneuvers at the Hunter Liggett Military Reservation in California where direct-fire simulators are getting their first severe test. You're a member of a tank-reinforced infantry company, and your orders are to defend Hill 502 from Blue Company.

Enemy troops supported by a tank are advancing toward your position. On your flank you see one of your tanks traverse its gun and fire. Almost immediately, smoke billows from the enemy tank and it grinds to a halt. Direct hit.

Without support, Blue Company infantry charge your position. You raise your rifle, sight on a target and pull the trigger. As the report of discharging ammunition echoes in your ears, you see your target fall to the ground.

There's no need for an umpire to rush over and tell the man he's been shot. He knows it as surely as if you had fired live ammunition instead of blanks.

Realistic combat simulation is something the Army has always tried to achieve. Not much headway was made, although some equipment was developed that promised more than it could deliver.

For example, about eight years ago a hit-kill indicator (HKI) was developed. It also used infrared light, but because of its giant-searchlight size the light source was too cumbersome to be supported by a rifle. It had to be worn by the soldier while the detector was placed on the soldier's weapon. This drawback created a situation that wasn't much more realistic than training exercises without HKI.

When a soldier saw an enemy and fired his weapon, all enemy soldiers in the vicinity were given an RF signal to light their infrared sources, because the only way an umpire could determine who was shot was to trace visually the light source on the target to the detector on the rifle.

HKI was all but dismissed by the Army and for a time it appeared that realism in combat-simulation training was a dream. Then, a new type of light source called a gallium arsenide laser (GaAs) was developed. So tiny that you can hardly see it with the naked eye, the GaAs diode once again offers the promise that simulated combat can be realistic and not a farce.

With DFS, umpires who accompanied opposing sides during maneuvers to arbitrate disagreements and determine who was killed and which side won the battle, are unnecessary. All action is automated. Men and equipment are automatically signaled when they've been knocked out of action. Photodetectors on the soldiers and tanks send a signal to a central computer system when they're "hit" by the infrared light beam. The computer, in turn, notifies the target that it has been destroyed.

A soldier who is shot is notified by



FRONT (lens) end of transmitter. Case contains battery power pack



INPUTS on transmitter sense blank has been fired and trigger laser, deactivate transmitter if "killed," select code assigned to transmitter

means of an audible signal transmitted to a small receiver he carries in his helmet.

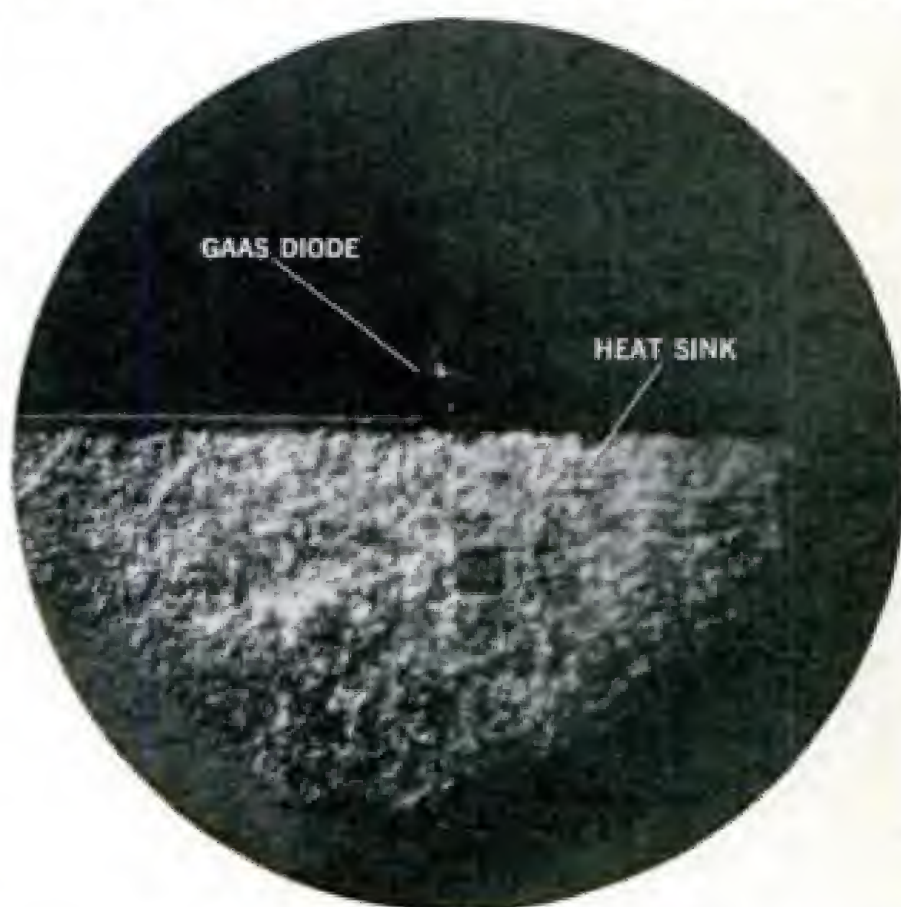
Every detail of the combat, from the "killing" of soldiers to the "destruction" of tanks, is transmitted to a central computer station where it is automatically plotted on a giant grid map. Tactical experts can get the big picture of how the combat and the theories concerning combat are progressing.

It may sound like all this needs a great deal of time to take place, and realism suffers because of it. The fact is that it takes less than one second from the time a soldier shoots at a target to the time the target learns that he or it is a casualty.

The heart of DFS is the gallium arsenide laser that's encased in a transmitter weighing less than two pounds. The transmitter is attached to rifles, machine guns and other direct fire weapons, including tank guns.

A GaAs laser has an extremely low energy output and isn't harmful to humans. In fact, the Army Surgeon General's office has established that the energy produced by a GaAs diode is perfectly safe. It's interesting to note, though, that should several of these diodes be wired together in series the energy they emit would be sufficient to burn the retina from a person's eye—just like any other type of laser.

However, I held my eye inches away from a GaAs transmitter, which uses a



DIODE (enlarged 42 times) is embedded in a copper heat sink to protect it from heat of transmitter

single diode, for a full minute without effect. You can't even look into a flashlight without feeling some sensation.

The semiconductor diode is made by diffusing arsenide to gallium. When current is introduced, an infrared light beam of about 9000 angstroms is generated. The visible portion of the spectrum is about 3000 to 7000 angstroms.

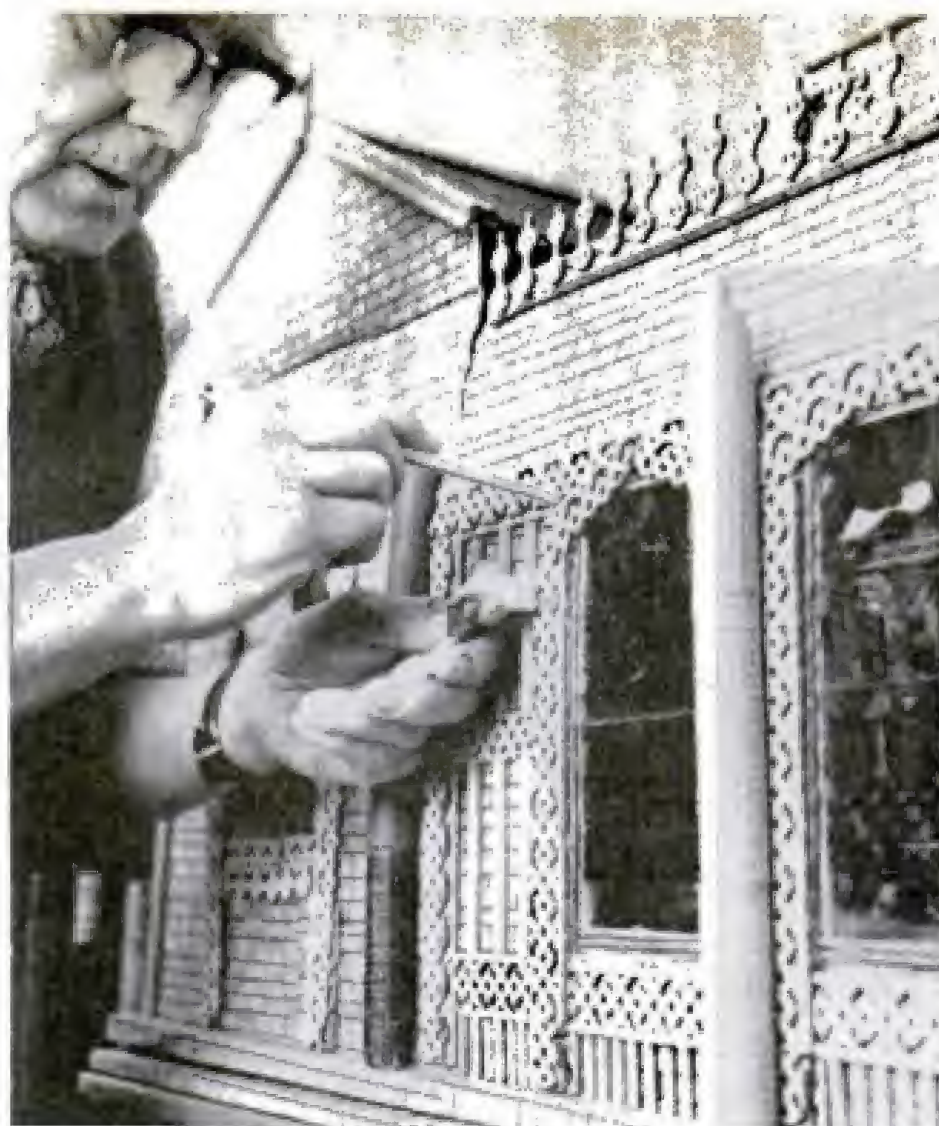
Electric current is provided by a battery pack in the transmitter. The beam of light cast by the GaAs diode is variable to simulate the range of the particular weapon to which it's attached. For example, transmitters that simulate rifle fire are programmed to cast their beams about 500 meters (approximately 550 yards). Those attached to tank

(Please turn to page 196)



Cathedral from trash

One of the lowest-cost construction jobs in history is this model of the Lincoln Cathedral by Freddie Brasher. It's made of junk—matchsticks, matchboxes, bleach bottles, egg boxes and the like—contributed by friends.



Bathroom on wheels

Two bathtubs for passengers and a com-mode for the driver, plus a supercharged Chrysler engine, make this one of the strangest cars on wheels. Builder is Bob Reisner.



New traffic circle

A once-congested intersection in Stuttgart now has a "roundabout" that lets traffic flow through on three different levels and, in addition, affords parking for 150 autos.



Mobile home Down Under

Mobile components are the building blocks of the "Mobile Habitation" proposed by a group of Australian designers. The ready-made fiberglass wings are designed to be trucked to the building site and bolted together.



Drinking man's automat

Just speak into the microphone and this automat will deliver your order: water, schnapps or whiskey. A Swedish professor programmed it to respond to three different sounds; he adds that it could be made to offer 10 choices.



'Cave for living in'

An 11-year-old English schoolboy, as a class project, designed this bit of foam-padded furniture and called it a "cave for living in." A manufacturer now wants to produce it.



Slot cars you ride in

Anyone over 10 can zip around the Scat Track, Scottsdale, Ariz., at speeds up to 50 mph and never fear collision or rollover. The racers travel around the one-fifth-mile course firmly attached to a channeled track by dollies (bottom photo).

AUGUST 1969



Built like a tree

Standard Bank Centre in Johannesburg, South Africa, will appear to be floating on air. Each of 27 office floors is suspended by prestressed cantilevered hangers from a central core with no supporting pillars. Architects have likened the building to a tree, where branches are supported by the trunk. A 50-ton beam slipped, delaying work, but completion is expected by December of this year.



Britain's biggest

Largest ship ever built in Britain, the 253,000-ton tanker *Esso Northumbria*, was recently launched from Swan Hunter shipyard.



AUTO RACING'S NEW SPEEDWAYS

Now second only to horse racing as the major American spectator sport, auto racing's mushrooming growth demands new facilities

By BILL KILPATRICK, Auto Editor

PROPHETS may be without honor here and there these days, but in the world of auto racing they're nothing short of demigods.

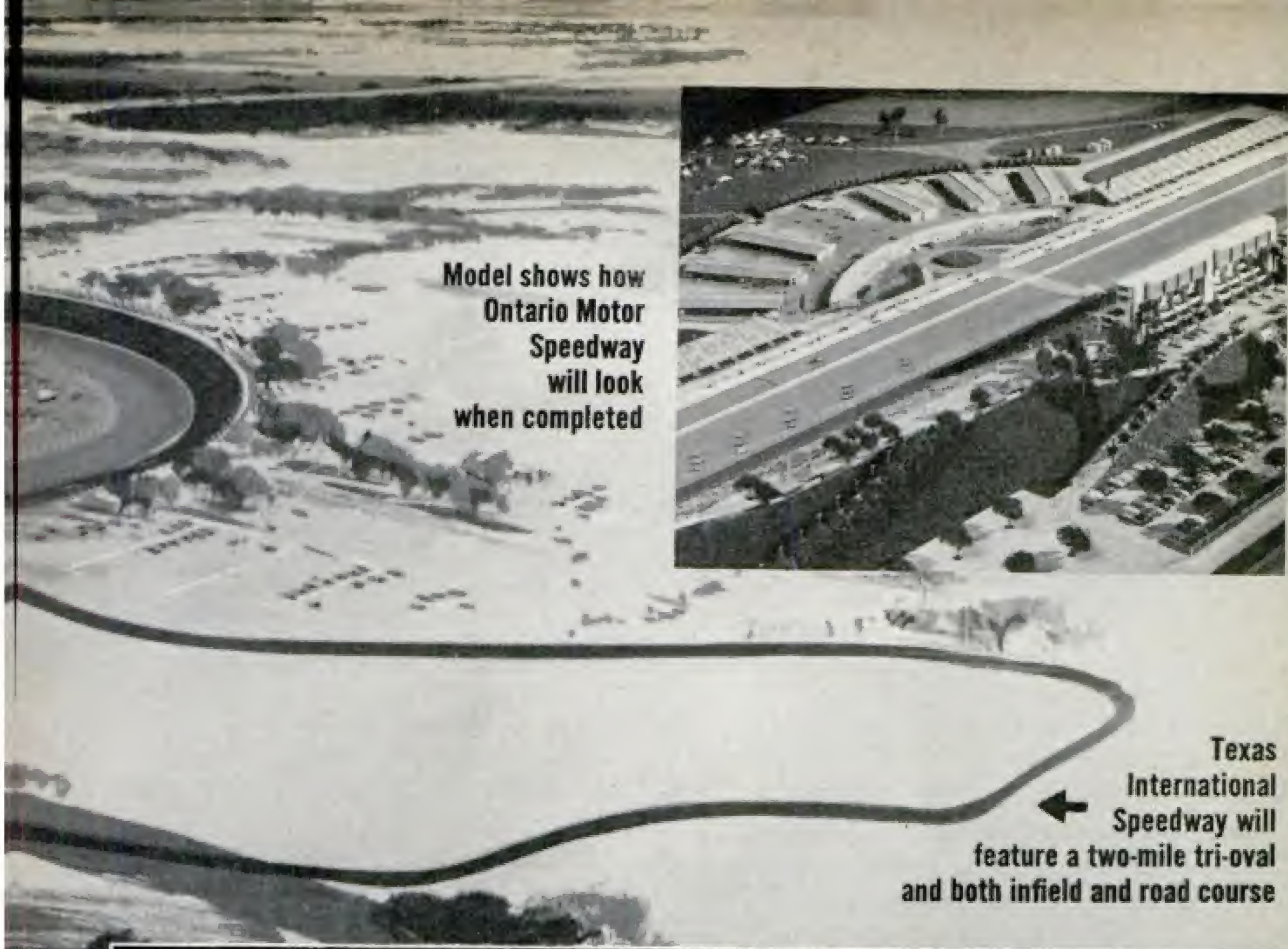
When they estimate—and accurately—that some 50-plus million Americans will storm the gates of the nation's ovals, drag strips and road courses this year, a small army of promoters, drivers, crewmen, car and accessory manufacturers, track officials and assorted hangers-on can hardly contain their glee. *This* is box-office action even the dimmest of bulbs can appreciate.

Underlining just how well the revenue produced by auto racing is appreciated is the interest in the sport shown by

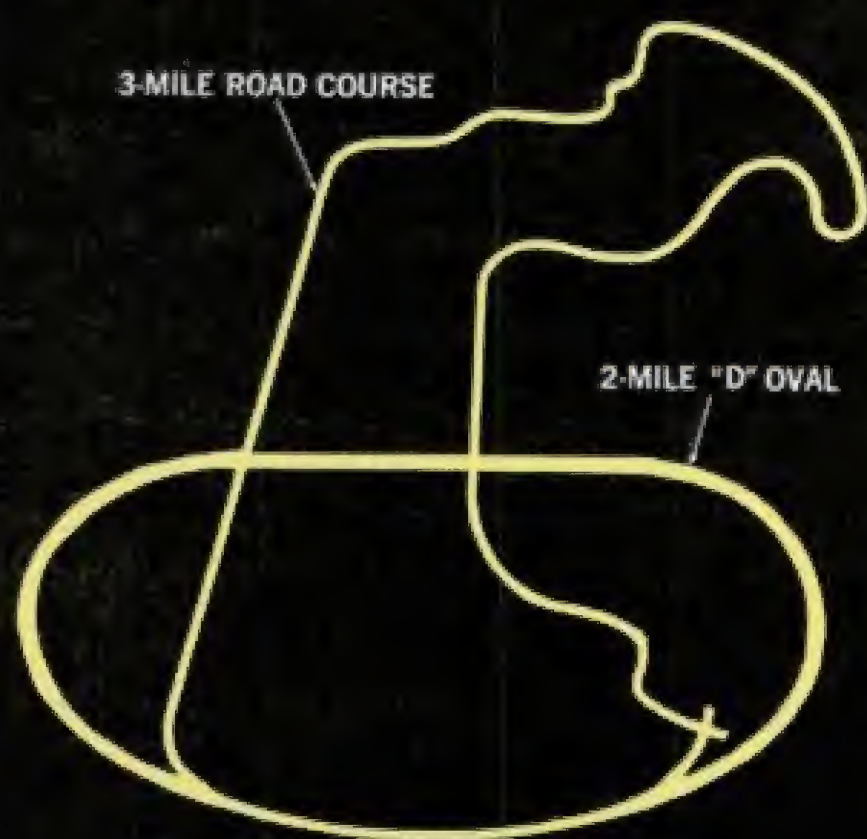
some really big shakers—conservative Wall Street investment types—a breed known to be interested only in “locked” propositions. Coupled with this interest by money men—in some cases the result of it—is the recent building of at least four major new tracks in such diverse locales as Michigan, Alabama, Texas and California.

The track in Michigan is located about 65 miles southwest of Detroit and is called Michigan International Speedway. It opened last October and drew a crowd of 55,000 to see a 250-mile race featuring big-name drivers in Championship (Indy-type) cars.

The Alabama International Motor



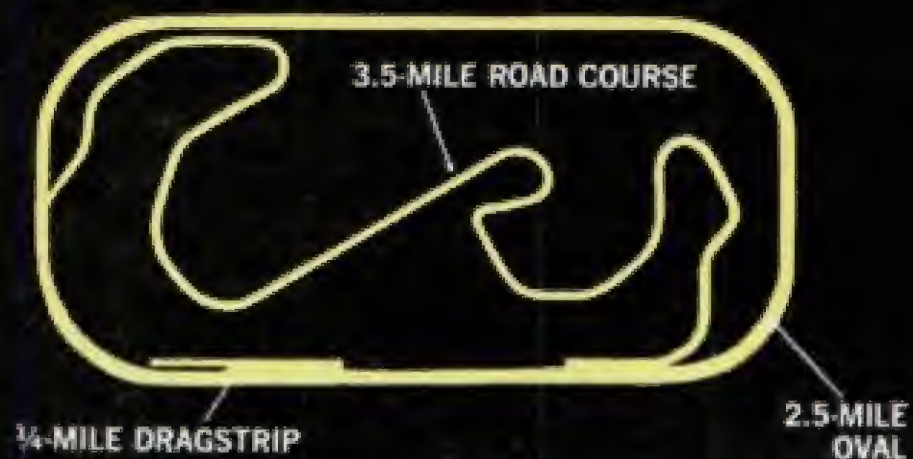
MICHIGAN INTERNATIONAL SPEEDWAY



TEXAS INTERNATIONAL SPEEDWAY



ONTARIO MOTOR SPEEDWAY (CALIF.)



ALABAMA INTERNATIONAL MOTOR SPEEDWAY





FEATURE of new speedways is good infield access. New Michigan track has four tunnels under main straight

Speedway is about 40 miles east of Birmingham on some 1800 acres in the shadow of the Talladega Mountains. (The track is popularly known as "Talladega" and in fact is the inspiration for the Ford car model of that name.) It's due to open next month with a big weekend of racing September 13-14. The main event will be a 500-miler featuring the stars of the NASCAR Grand National stock-car circuit. Thanks to Talladega's 33° banking, speeds could top 200 mph.

Due to open this November is Texas International Speedway, located about 70 miles northwest of Houston. Management is the same as that of the Michigan track. (Incidentally, the group—headed by Detroit financier Lawrence LoPatin—recently acquired Riverside International Speedway in California, along with its popular promoter, Les Richter, who is now director of operations of all of LoPatin's tracks, including the 1½-mile oval at Atlanta.) The new Texas facility is being built on a 2600-acre site near College Station, home of Texas A&M. Action gets under way Nov. 9 with a 200-mile Can-Am race. NASCAR will also use it.

What may be the most ambitious of the new tracks is under construction at Ontario, Calif., about 40 miles east of Los Angeles. When completed (it's due to open next July), Ontario Motor

Speedway will offer seating for 140,000 including permanent grandstand seating for 85,000 (Indianapolis can seat over 200,000). The track is being built on a 700-acre site, 30 acres of which will be infield set up to handle an additional 70,000. Ontario is located about 20 miles closer to Los Angeles than the established Riverside track, and insiders forecast a tremendous rivalry between the two. This could mean escalated purses for drivers and car owners.

Another potential major-league racing complex is under construction on

MOUNTAINS of earth must be moved to carve new track. Here engineers check Talladega infield access





SPEEDS approaching 200 mph are forecast for the new Talladega racetrack, thanks to its high 33° banks

over 1000 acres 75 miles north of Philadelphia in the Pocono Mountains. Called Pocono International Raceway, the track, scheduled to be completed next spring, will offer a 2.5-mile oval and a $\frac{3}{4}$ -mile oval and dragstrip.

Still another major racing facility is being planned for the megalopolitan area around New York by Michigan's LoPatin and his associates. No site has as yet been announced but when and if the track is completed it will have a potential fan population second to none.

What kind of money is involved in building these tracks? *Big* money, and lots of it!

Michigan cost almost \$6 million to build, about what it will cost to finish the Texas facility. Talladega will wind up costing its backers well over \$5 million. Ontario, again the most ambitious undertaking of the lot, is earmarked at a cost of \$25.5 million, \$6 million of which was spent just acquiring the land upon which the track is being built. Pocono, the financing of which has been a drawn-out, close-to-the-vest affair, will have cost more than \$5 million by the time it has been completed.

Just in these tracks alone, upwards of \$50 million is being spent, an eye-popping investment in a sport that just a few years ago was confined to three or four major speedways and scores of small-time "bull rings" scattered throughout the country. And best of

all for the money men is that profits seem as inevitable as taxes.

As a rule, unless they are going under, racetrack managements are reluctant to disclose just how much their box-office action amounts to. But in 1968, the International Speedway Corp., proprietor of the famed 2.5-mile superspeedway at Daytona and the track under construction at Talladega, took in some \$1.6 million in admissions alone. Add to this additional income (concessions, track rental for testing and so on) of \$0.5 million taken in during 1968 and you get a fair idea of why Wall Street ears go up at the mention of auto racing.

Actually, however, favorable earning potential is only part—the major part, granted—of the impetus behind the big boom in racetrack construction. Also to be considered is that space-age technology is boosting speeds up and up, meaning most existing tracks—particularly the smaller ones—just can't handle today's race cars and racing. Additionally, although still an extremely hazardous, give-no-quarter business, auto racing is losing its old bloodthirsty, roughneck image. Around most tracks these days clean fingernails outnumber dirty ones and down in the pits or up in the stands one is very apt to find the man-next-door.

Finally, of course, there's auto racing's ultimate appeal . . . its fantastic spectacle. ★★★

Who Will Bell the Invisible CAT?

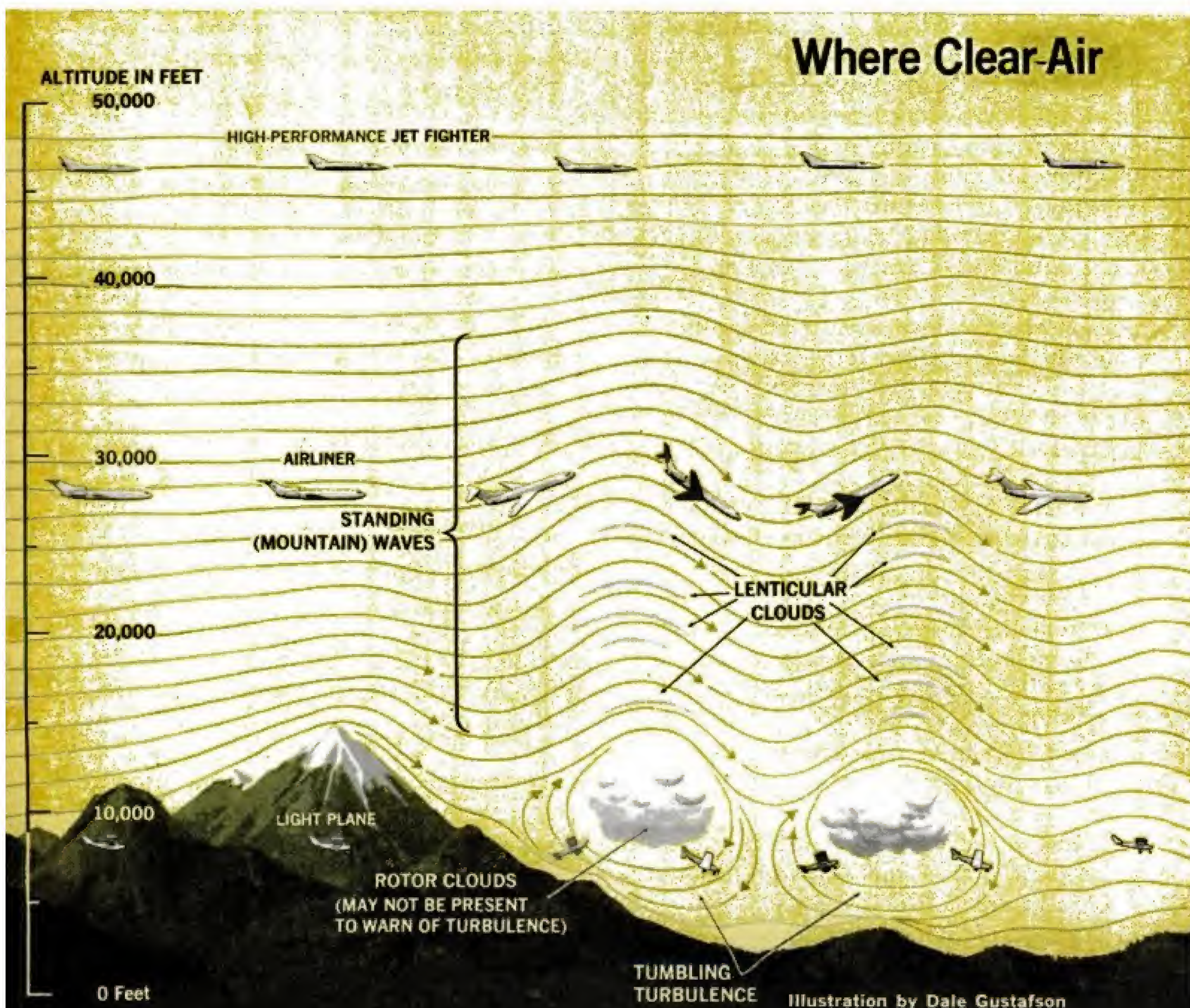
By FRANK A. TINKER

Air Force, Federal agencies, plane-makers, airlines—they're all trying to find better ways of combating a sky foe called Clear-Air Turbulence

IT SEEMED TO BE a routine flight, well above the clouds and in air so smooth that half the passengers had been lulled to sleep. Why, then, the sudden excitement among the observers up forward who were clustered around a "black box" instrument?

Two warning lights on the box had begun to glow. "About three and a half away," said one of the engineers in the group. There was sufficient time, the observers knew, to alert the flight crew, switch on the seat-belt sign, and slow the big jet to a speed at which it would better withstand penetration into turbulent air.

Turbulence—in this clear sky? Yet, three and a half minutes after the black box's first warning, a shudder ran through the plane. For several minutes



the craft pitched, rolled and surged as if it had suddenly entered an invisible thunderstorm. Objects not secured went skidding off passengers' laps. Bodies strained against seat belts, and passengers glanced in concern and puzzlement at the seemingly tranquil skies outside. Then, as suddenly as it had begun, the turbulence subsided.

"We hit that kitten right on the nose," said one of the observers.

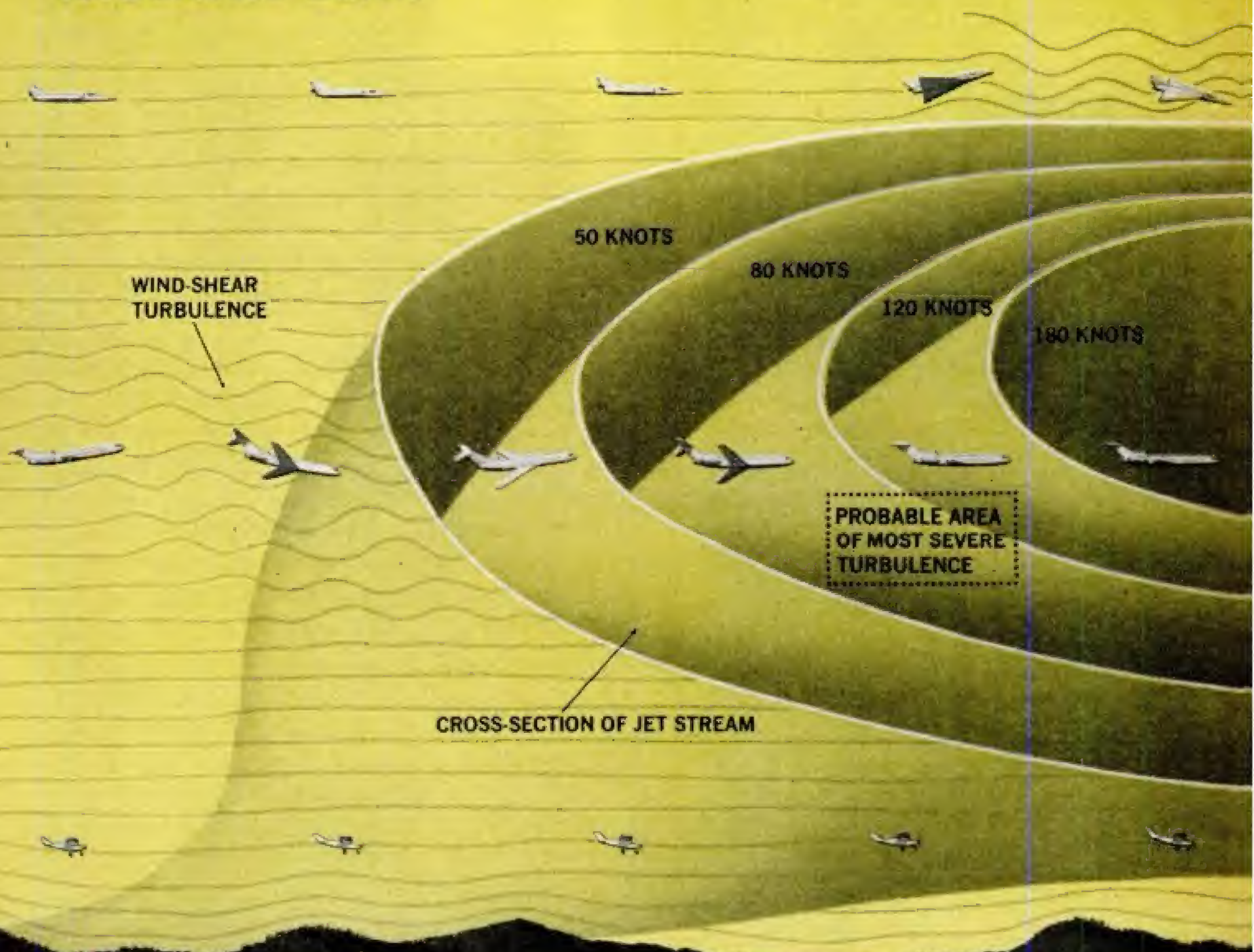
They had, indeed, and it is hoped that such test flights, similar to many recently flown on regularly scheduled runs, will eventually succeed in belling the same cat. For this is no ordinary feline. It is a high-living, vicious CAT—Clear-Air Turbulence—which has claimed lives and aircraft.

In 1964 a highly instrumented B-52 flew over Colorado's Sangre de Cristo

SENSITIVE VANES at end of 8-foot boom register wind velocities in this high-flying CAT-hunting U-2



Turbulence Lurks



FATAL CRASHES HAVE BEEN TRACED to clear air turbulence, an elusive enemy of aircraft. Diagram shows where it may be found



CAT INDICATOR IS INSTALLED on engineer's panel of Pan Am 707. When indicator shows a sudden temperature change, crew knows CAT may be ahead



DATA RECORDED ON FLIGHT is checked out by technician prior to laboratory analysis. Many research flights are made over regular commercial air routes, but some cover mountain areas known for extreme turbulence. Before leaving on CAT-seeking mission, Air Force pilot (below) gets briefing by forecaster



Mountains in search of gusty weather in which to carry out structural tests. The plane hit stronger blasts than its crew had bargained for. Seized by CAT, the craft threatened to go out of control. Powerful gusts ripped the rudder completely off and stripped the vertical stabilizer down to a bare stub. It took real piloting and good luck to bring the plane to a safe landing.

Civilian airliners have not been immune. In 1968 a United Air Lines jet was on a routine flight over Wyoming in otherwise ideal conditions when struck by CAT. It plunged 8000 feet. A passenger who unfastened his seat belt to assist another was bludgeoned to death against the cabin ceiling.

The year before, a British airliner ventured too near the unseen gusts which often swirl over Japan's Mount Fuji. It was literally torn apart by the turbulence, bringing death to all on board. On numerous other occasions flight personnel, passengers and baggage have been flung about the cabins of CAT-clawed aircraft. In addition, CAT is suspected of being a major cause of structural damage that doesn't show up immediately and is an important factor in unsolved crashes.

Not long ago it was assumed that the greater the altitude, the smoother the flight. Today we know that this isn't necessarily so.

Designers of high-flying craft, particularly supersonic transports, must take into consideration stresses associated with clear-air turbulence. The inherent flight stability of swept-wing jets may be especially vulnerable to CAT. At lower speeds the choppy jolts and severe lateral gusts might not be critical, but at 2000 mph the rapid cycles of vibration set up by these forces might result in structural failure.

To coordinate a broad investigation of the problem, a National Committee for Clear-Air Turbulence was set up in 1966. One of its first recommendations was that, although aircraft had to be able to survive CAT if encountered, the best way to deal with it was to

avoid such encounters. But how? That angle is still being investigated.

The Air Force has a long-standing interest in CAT, whose disruptive forces may play particular havoc with mid-air refueling operations. Early research was focused on a particular phenomenon, the jet stream, which was soon linked with CAT. World War II pilots first reported finding the jet stream, but were scoffed at by weather people. Now it is known that this wind system is a flow of fast air that may be from 50 to 300 miles wide and 3000 feet thick. It is a west-to-east stream that shifts its course almost hourly, with winds of from 100 to 300 mph. Near its edges the jet stream collides and "shears" with the surrounding air, creating severe turbulence. In addition, the stream it-

vanes so sensitive they can detect a man's breath. Long-winged U-2s and Lockheed SR 71s have detected CAT as high as 80,000 feet.

As a result of these many probes the Air Force has confirmed the potential hazard of CAT to planes flying at supersonic speeds. To avoid this hazard, aviation thus far has had to rely mainly upon forecasters, who can predict general areas of possible turbulence.

Most of the predictable turbulence, however, occurs at just those levels—20,000 to 40,000 feet—where most jets in the civil, airline and military fleets must operate.

A typical CAT forecast zone is huge—400 miles long, 120 miles wide and 15,000 feet thick—and there may be several forecast at the same time.



PILOTING SKILL AND LUCK joined forces to bring this B-52 back safely from mission in mountains over Colorado. Seeking gusty weather, research plane was hit by CAT that chewed its vertical stabilizer to a stub

self may contain waves of wind which produce the curious "chop" frequently associated with CAT.

The Air Force program is divided according to altitudes—Locat, Medcat and Hicat. Much of this effort initially went into investigating Medcat—from 20,000 to 40,000 feet—where the jet stream normally occurs. But with the first U-2 and B-58 flights came a surprising discovery—CAT also lurked well beyond those altitudes. For several years now such planes have roamed the skies over Puerto Rico, Alaska and Australia. The U-2 is fitted for these missions with an eight-foot boom jutting from its nose. At the end of the boom are several

Pointing this out in a special report, the National CAT Committee states that such forecasts still are "too gross to be of much value for (flight) planning purposes and the chance of encountering CAT is almost as great outside the forecast area as within."

Radar, so useful in detecting and avoiding "cells" of precipitation and presumed turbulence in thunderstorms, has proved of almost no value in detecting CAT. Radar needs something "solid"—rain or clouds—to reflect it. Investigators finally hit on one possible CAT indicator: The jet stream or any rapidly rising or falling current may

(Please turn to page 198)



A Nifty and Thrifty Buy, But How the Money Goes for Gas!

By **BILL HARTFORD**, Technical Auto Editor/Photos by Irv Dolin

OWNING AN IMPALA is a simple economic proposition. Owners have to drive to live: "Faithfully gets me to work and back—80 miles a day," states a Minnesota foreman. Take the best price from among a couple of quotes for the car with the comfort, style and performance needed, add on depreciation, approximate miles per year, figure in maintenance, repairs and so on, and reach a conclusion: "It's a car to keep for two years; if it doesn't fall apart it's served its purpose. I don't marry a car, it's inanimate," explains a New Jersey stockbroker.

It's something to use and throw away at the least possible expense. "It's good for the average income family; got good trade-in or resale," deduces an Arkansas rural mail carrier.

According to owners, it's arithmetical gymnastics that swings them to the Impala. "It's cheaper than other cars. It cost me \$1000 less than the same size Pontiac. I try to trade every year; I'll buy a Chevy in 1970 only if other cars are so highly priced to allow me terrific



REAR VISIBILITY is much complained about. Owners can't see the rear fenders for parking and backing



REAR-SEAT KNEEROOM is a bit tight even in four-door model, but owners like comfort and upholstery

savings by staying with Chevrolet. Best \$ value," analyzes an Alabama program analyst.

After putting all the facts into their mental computers, owners reach a dollars-per-day figure that tells them how much they've got left for apple pie or reminds them how much we need more mass transportation. "Less depreciation during ownership than with other cars," observes a Nebraska salesman. "Retains a high trade-in value," says a Colorado rehabilitation counselor.

Many owners sell or trade just before they figure the original battery and tires will poop out, or even before the radiator has to be flushed, as the case may be: "Fourth Impala in four years," is the tally of an Illinois housewife. "I buy one each year," says a retired Indiana man. An Illinois manufacturing coordinator and others do the same. A rural mail carrier quips, "I've driven 11 Impalas in the last six years—all satisfactory."

What begins as an economic proposition often becomes an allegiance of affection and pride—or habit. A retired teacher in Indiana has been driving Impalas since Chevrolet introduced the marque. "After 40 years with GM cars—Chevys and Buicks," a Louisiana revenue auditor bought his '69 Impala. An Indiana book-

AUGUST 1969



DRIVER'S ASHTRAY is too close to knee; it's only one in front; passengers can't reach it, say owners

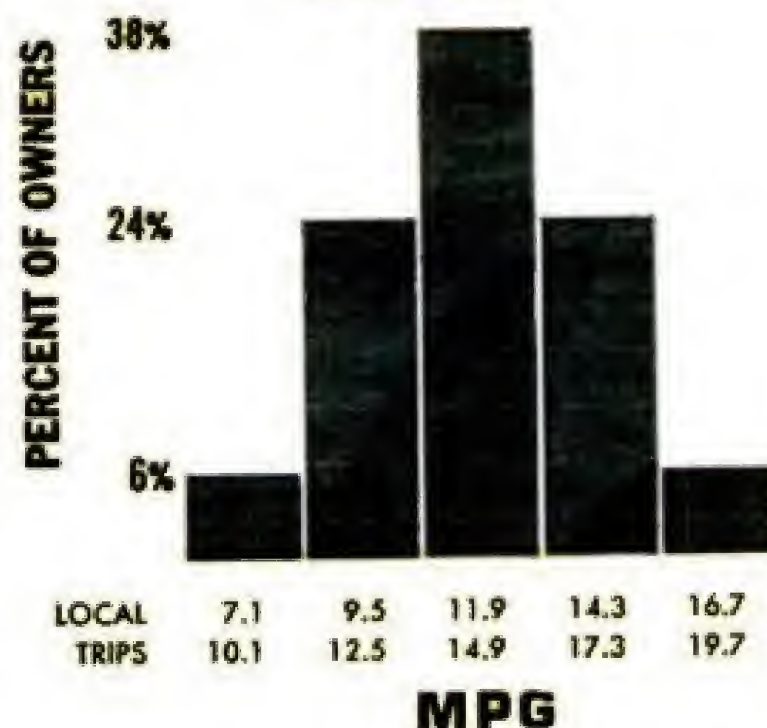


CONTROLS, INSTRUMENTS are liked. Exception is hard-to-use horn buttons; owners want ring



SMART FRONT-END STYLING is only one element of Impala's overall design that excites owners

IMPALA FUEL MILEAGE CHART 327-cu.-in. V8





ON-THE-ROAD, OWNERS average 14.9 mpg, around town, 11.9 with most popular 327 V8—and they don't like it



BEHIND-THE-WHEEL POSITION is comfortable; front visibility to the right is interrupted by the mirror

keeper put 100,000 miles on his '64 "with no major trouble"; that's why he bought a new one. In fact, good past experience with Chevrolets (specifically, Impalas) brought most '69 owners into the showroom ready to buy.

Now that these owners have, cumulatively, over a million miles on the road, they've had a chance to discover the things that they don't like about their Impala. Fuel consumption is, by far, most disturbing. Over half of owners have the 327-cu.-in. V8 and are averaging 11.9 and 14.9 miles per gallon in town and on trips, respectively. They voice their complaints regardless of whether their mileage is below, above or the same as the average. "Gas mileage is poor," mourns a Delaware accountant getting 7.5 and 10 mpg. "Gas mileage is pathetic!" exclaims a



IN THE TRUNK there's all the room owners need; only a few mentioned the spare tire being in the way

Virginia electrical engineer getting 10 and 12 mpg. "Poor gas mileage," complains a Connecticut truck driver with an above-average 14 and 17 mpg.

A New Jersey modelmaker says that "after all these years of automotive engineering experience, the industry owes more to a customer than a drop from 25 mpg in 1933 to 8.4 mpg in 1969 regardless of the hp race." That's the mileage he's getting with his 396 engine. His mileage has decreased progressively over the years as he indicates in a comprehensive log of his family's Chevys, vintage 1933, '40, '41, '54, '62, '64, '66, '67 and '69.

Dissatisfaction with fuel economy overshadows other things about the Impala. Complaints about rear visibility and lapses in workmanship are mild in comparison. Only the "lemon" the-



CHOICE OF MODEL is overwhelmingly four-door sedan or hardtop. It's only car for half of owners surveyed

ory or some mysterious psychological reason for owner dissatisfaction can explain such a strong but rare comment like that made by an Alabama truck driver: "I'll drive it until it wears out, but at the rate it's going it won't be long." Similarly, a Delaware accountant complains about poor visibility out the rear window of his four-door sedan. "There's absolutely no good rear view, and I've bumped into another car twice because of this." He's the only owner for whom it's *that* bad.

After the best and worst things about the Impala are listed, all the remaining praise and criticism balance out. For every owner who got the royal treatment from his dealer, an-

IN THE TURNS owners find Impala predictable; like handling second to style; comfort and ride are next

other got the runaround; for every owner who likes the horn buttons, another wants the familiar horn ring back; for every owner who wants a side vent window back, another owner is glad it's gone; for every owner who dislikes the use of plastics, another praises it; for every owner who wants a second ashtray up front for the passenger, another has no need for it; for every New Jersey safety inspector who says, "The car rattles like a tin can," there's a Nebraska machinist who brags, "You can race the car every day and it will take it." But when it comes to balancing the budget, most owners agree with a Delaware salesman; simply, "It's a good investment." ★ ★ ★

Summary of 1969 Chevrolet Impala Owners Report*

Total miles driven1,288,272

Average miles per gallon:

327-cu.-in. V8, local driving 11.9
long trips 14.9
350-cu.-in. V8, local driving 12.3
long trips 15.0
396-cu.-in. V8, local driving 10.9
long trips 14.5
250-cu.-in. Six, 427-cu.-in. V8: not available

Specific likes:

Style36.4%
Handling29.9
Comfort28.0
Ride27.6
Economy15.4
Performance15.0
Power8.9

Specific dislikes:

Gas mileage21.9%
Workmanship13.2
Dealer service7.5
Wind noise7.0
Rear visibility6.6
Rattles5.7
Tire quality5.3

What changes would you like?

Rear visibility14.4%
Workmanship9.9
Quality of materials8.3
Side vent window6.6
Ashtray location4.4

Body style:

4-door sedan42.0%
4-door sport sedan25.1
2-door sport coupe20.6
2-door custom coupe6.2
2-door convertible6.2

Engine:

250-cu.-in. Six0.4%
327-cu.-in. V855.7
350-cu.-in. V835.7
396-cu.-in. V86.6
427-cu.-in. V81.6

Transmission:

Automatic94.2%
3-speed manual3.7
4-speed manual2.1

Had any mechanical trouble?

No71.4%
Yes28.6

What kind of trouble?

Windshield wipers15.7%
Power steering14.3
Transmission11.4
Oil leak11.4
Carburetor10.0
Cold starts10.0

Dealer repair satisfactory?

Yes62.1%
No37.9

Why the Impala?

Past experience46.2%
Economy29.2
Style19.5
Performance5.5
Service (dealer)5.0

Is the Impala your only car?

Yes50.6%
No49.4

Other cars owned:

Chevrolet57.1%
Ford13.4
Corvair7.6
Volkswagen6.7
Oldsmobile5.9
Buick5.0

What options/accessories?

Both power steering and brakes56.0%
Radio54.2
Airconditioning51.4
Power steering40.7
Tinted glass25.5
Whitewall tires18.5
Clock13.0
Vinyl top9.3
Rear speaker7.9

Age distribution of owners:

15-2916.3%
30-4951.0
50 plus32.7

*Where applicable percentages may not equal 100 percent due to rounding and/or insufficient sample.

Off-Road Going ...In Style

In May we reported on our first quick look at International's new Scout Aristocrat. On our second look, we wrung it out in the rugged Smokies

By BILL KILPATRICK, Auto Editor

HEADED SOUTHEAST out of Knoxville on U.S. 441, I noticed other drivers giving me the eye whenever I zipped by on the inside lane. It must have been obvious I was driving something different. The fact I was zipping by at all probably was the main reason for the curiosity; 4x4s aren't supposed to blow the doors off Buicks.

Yet there I was, doing the limit and—occasionally in passing situations—a bit more. And when the name "International" is coupled to a squarish box-on-wheels that on any day can get right out there and march with the rest . . . well, we have a genuine vehicular curiosity, that's what we have.

The vehicle was International's plush, new Aristocrat, a once-was meat-and-potatoes Scout 800A with clean fingernails and slick hair, and the reason I could show my heels now and then was a 304-cu.-in., 193-hp V8.

Add splashes of chrome trim and such go gear as mag-type wheels and wide, performance-type tires, and we have even more of a curiosity—the sort one figures to see only around Los

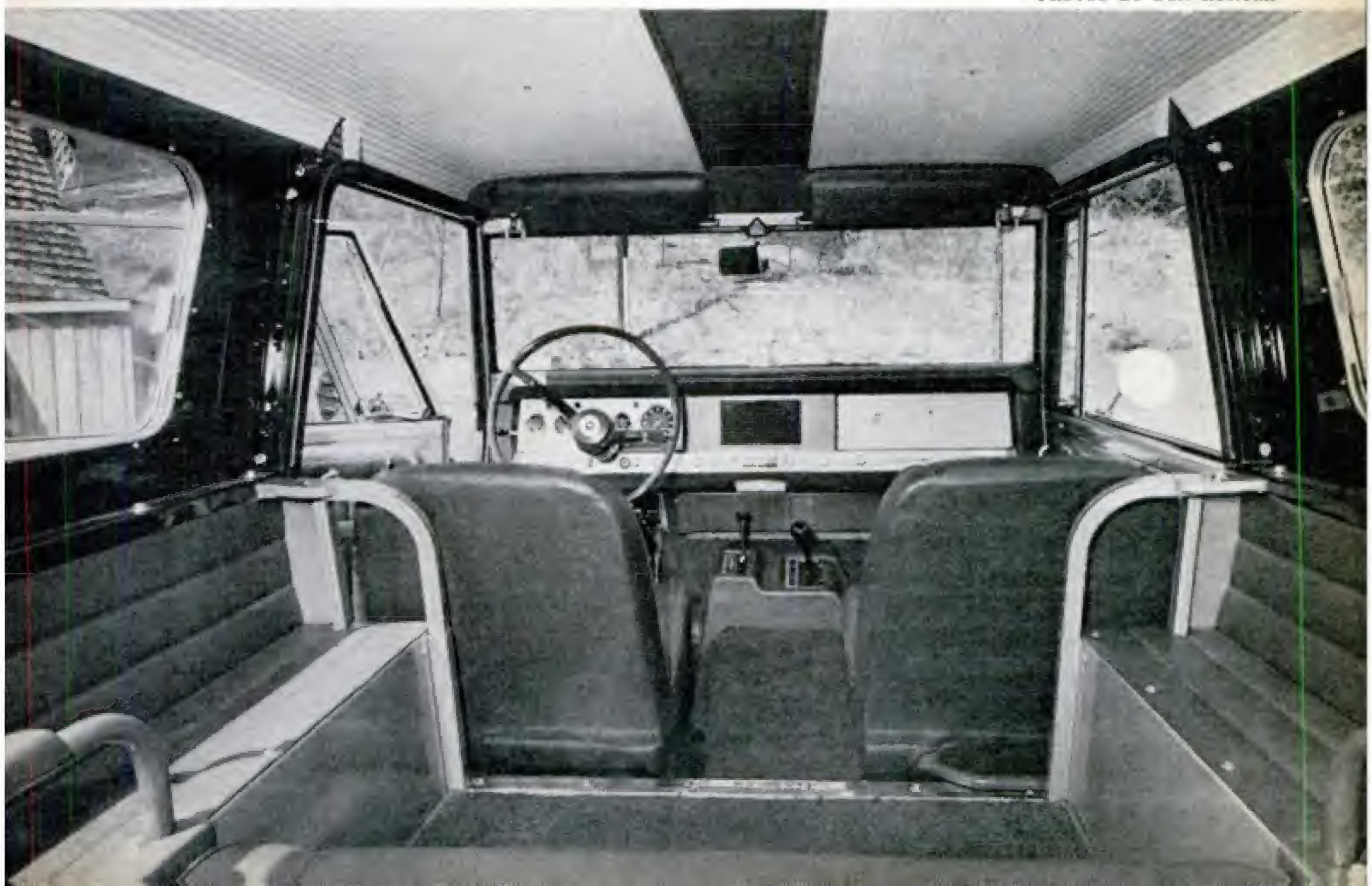


VERSATILE ARISTOCRAT takes shallow streams with ease. Below, mag-type wheels and front locking hubs



ACCESS to rear seat is via fixed, forward-pivoting passenger seat. Aristocrat comes carpeted throughout

PHOTOS BY DON HUNTER



Angeles. There were some startled Mustang faces when I went bombing by.

But speed and styling dash aren't supposed to be the name of the 4x4 game. The idea of such a rig is go-anywhere versatility—through streams, up steep inclines, punching out trails in the bush, threading trees and so on. Could the Aristocrat—for all its zip and grooming—still slog along in rough country like a regular Scout? Finding the answer is why guys who test-drive automobiles occasionally complain of aches and pains.

A few months ago, *PM* executive editor Jim Liston got to drive briefly a prototype Aristocrat (see *It Separates the Ranchers From the Cowboys*, page 90, June *PM*) and returned impressed.

"It's an interesting concept," he reported, "but I didn't get a chance to find out just how interesting. See if you can set up a real test."

So there I was, southeast of Knoxville, flailing my way through a maze of roadside signs in the first Aristocrat off International's Fort Wayne production line. Ahead was my "test track"—the Great Smoky Mountains. There I would find the sort of rugged backwash deemed a 4x4's meat.

It was, too. I drove the Aristocrat back and forth through a couple of rocky streams, up and down crude trails and roads, through a sharply inclined meadow, up and down over sharply-cornered switchbacks—all the while admonishing myself to not judge the unit as an automobile, but rather as the unique type of vehicle it was.

For example, personal handling criteria I would apply to, say, a Plymouth Road Runner has no bearing on a 4x4. With each yaw, pitch, and jolt to my spine, I kept reminding myself that I wouldn't be there in a Plymouth in the first place; a fisherman intent on getting back in where the lunkers lurk isn't too concerned about independent suspension. He wants to get there. The Aristocrat will do handily... and in style.

But the ride is rough. There are solid axles fore and aft, the former slung

beneath eight-leaf springs on either side, the latter, four. The front seats are quite comfortable, albeit the driver's seat didn't slide back far enough for me. The passenger seat is fixed. The rear seat is little more than a two-man, padded fixed bench and a half-hour back there is plenty.

There was too much play in the steering wheel of the unit I drove; coming down to the Great Smokies I was at the whim of every little crosswind. But don't forget the unit was the first one off the line and hadn't been thoroughly checked out at the factory. Also, I thought the turning radius was too large for a 100-in. wheelbase vehicle; taking advantage of available power in a cornering situation can get you into a somewhat scary understeer condition.

Getting the Aristocrat in and out of four-wheel drive is quick and simple. The transverse case is most easily operated while the vehicle is in motion. Operating the case is via a single lever.

The unit I drove had a three-speed automatic transmission, power brakes, twin gas tanks (controlled via a floor-mounted valve), and such niceties as a map light, radio and individually-controlled windshield wipers. Power, as mentioned, was a V8, although you can get either a Four or a Six. Atop the unit there's a chrome luggage rack and inside there's carpeting throughout.

In all, a pretty (for the type), spunky, rugged little package. And it ought to be. The sticker price on the unit I drove was \$4097, a goodly sum for what is—essentially—a recreational vehicle. But if you want it for workaday use, it's nice to have all those luxury touches, and being able to keep up with—even pass if need be—the mass-produced prides of Detroit is almost worth the price of admission. But hurry; International doesn't plan to make more than 2500 Aristocrats. ★ ★ ★

ROUGH ROADS, steep inclines are duck soup for the Aristocrat. Four-wheel drive coupled with V8 power provides outstanding off-road performance. Chromed-steel luggage rack is standard equipment





ICE SCREWS are used to climb overhanging ice cliff on glacier

What It Takes

Ice climbing on mountain glaciers is a fast-growing sport. What you need in nerve and equipment is demonstrated here by expert guides who now must be certified in National Parks

By BOB and IRA SPRING

Photos by the Authors

MOUNTAIN CLIMBING is literally an uphill fight. Nevertheless, tens of thousands of people this year are being attracted to the steep slopes and high altitudes of mountains in our National Parks.

It's the new lightweight equipment that makes this rugged sport more appealing. The rapid increase in climbing popularity is outpacing the Park Service's ability to know, personally, the good climbing guides. Thus the Service

GUIDE LOUIS WHITTAKER rappels from a large ice tower on Cowlitz Glacier

POPULAR MECHANICS

has set up a new certification program.

Professional guides now must show off their talents to the NPS and get a permit before they can lead the uneducated up precarious peaks. Tests are more demanding if the peaks are covered with ice.

Head of the guide-testing program is Louis Whittaker—twin of Jim Whittaker who was the first American to reach the top of Mount Everest.

Guides specializing in ice climbing will be put through their paces at Camp Muir—a small hut on a wind-swept ridge 10,000 feet up Mount Rainier, Wash. The test "ground" is the nearby ice of Cowlitz and Muir glaciers.

The examination goes far beyond a guide's ability to climb—he must prove he can lead. The guide is responsible for his party. On a mountain his word must be law. To gain this leadership experience, a potential guide must spend a year or more as an apprentice

to Become a Surefooted Iceman

no matter how great a climber. But there's more than leadership.

A professional guide will be tested on glacier knowledge and on his savvy of strange mountain weather.

He will guide people with little or no knowledge of climbing. He will have to tie the climbing ropes of his party with simple foolproof knots. The guide must remember that in case of a fall, the novice doesn't know how to stop himself. And the novice is more likely to fall. The guide must take special pains with novices, yet do it so the climb is not delayed. He must pass these tests.

Guides must be able to teach their parties the basic technique of walking on snow; of self-arrest in case of falls;



DANGEROUS SNOWBRIDGES cover crevasses, making them traps for unsuspecting glacier climbers. Self-arrest and self-rescue are important when climbing ice

MODERN EQUIPMENT now makes climbing a much easier sport. Ice screws hang from climber's belt



Surefooted Iceman



THIS CLIMBER is descending a tension traverse across a bergschrund (a crevasse with a high ice escarpment.)

A CHIEF GUIDE rappels, lower left, from a large serac (a high ice tower) on Cowlitz Glacier on Mt. Rainier.

GIRLS take ice climbing course, too. Below are shown two students practicing self-rescue from a deep crevasse.

LEAPING OFF lowering ice cliff, right, is a chief guide. A safety rope is attached to a belt around his waist.







THE JUMAR ASCENDER is an important new device used by mountain climbers to get up and down guide ropes more easily. It was developed in Switzerland



TWELVE-POINTED ICE CLEATS are now being used on new double-thick climbing boots. The new cleats allow for two forward spikes, useful on ice and snow

of crevasse rescue. The techniques used are different for ice climbing than for rock ascents.

Hand and footholds on a rock cliff don't exist on glaciers. Pitons driven into tiny cracks in rocks for vertical climbing are completely useless in ice. With rock there is relatively little danger of a peak collapsing or of a climber falling into a hidden crevasse. But then again, ice climbers can cut steps in cliffs—tough to do in rock.

Ice guides must know about ice screws and what hardness of ice takes which type of screw. The potential

guide is tested on use of the Jumar ascender—a mechanical device which slides up and down climbing ropes.

Coathangers are important, too. These are large wooden ice screws which freeze in position.

And finally, the guide must know how to make a bridge when a crevasse is too large to walk around. He lowers himself to the bottom, then using ice screws, climbs out the other side. Once on top, he engineers a rope bridge for his party. Those who pass the Park Service certification test can truly call themselves surefooted icemen. ★★



TUBULAR ICE SCREWS (left) are used in soft snow. Snow in hollow middle freezes, helps keep screws in place. Other important gear (below) includes coathanger screws (bottom left) and snap rings





Crewless minesweeper

A radio-controlled, 23-foot-long drone (MSD) has been developed for the dangerous job of minesweeping close to shore in Vietnam. The high-speed drone (foreground) is operated from a Minesweeper, Patrol (MSR).



Tent from a poncho

The ponchos that British soldiers wore during recent exercises in Iceland had a second use. With pegs and poles, the garments converted into tents. Each soldier carried from 60 to 80 pounds of gear.



New challenger

Phil Read, champion racing cyclist, inspects a mock-up of the Read-Weslake 500-cc. Grand Prix challenger. The engine is designed to produce 70 to 75 bhp—which will make it Britain's most powerful twin-cylinder.



Zoo with invisible bars

No bars or glass confines birds in the Antwerp Zoo. Only fear of the darkened room in which visitors stand keeps the diurnal birds from leaving lighted displays. After visiting hours, blinds (shown) close off the displays.



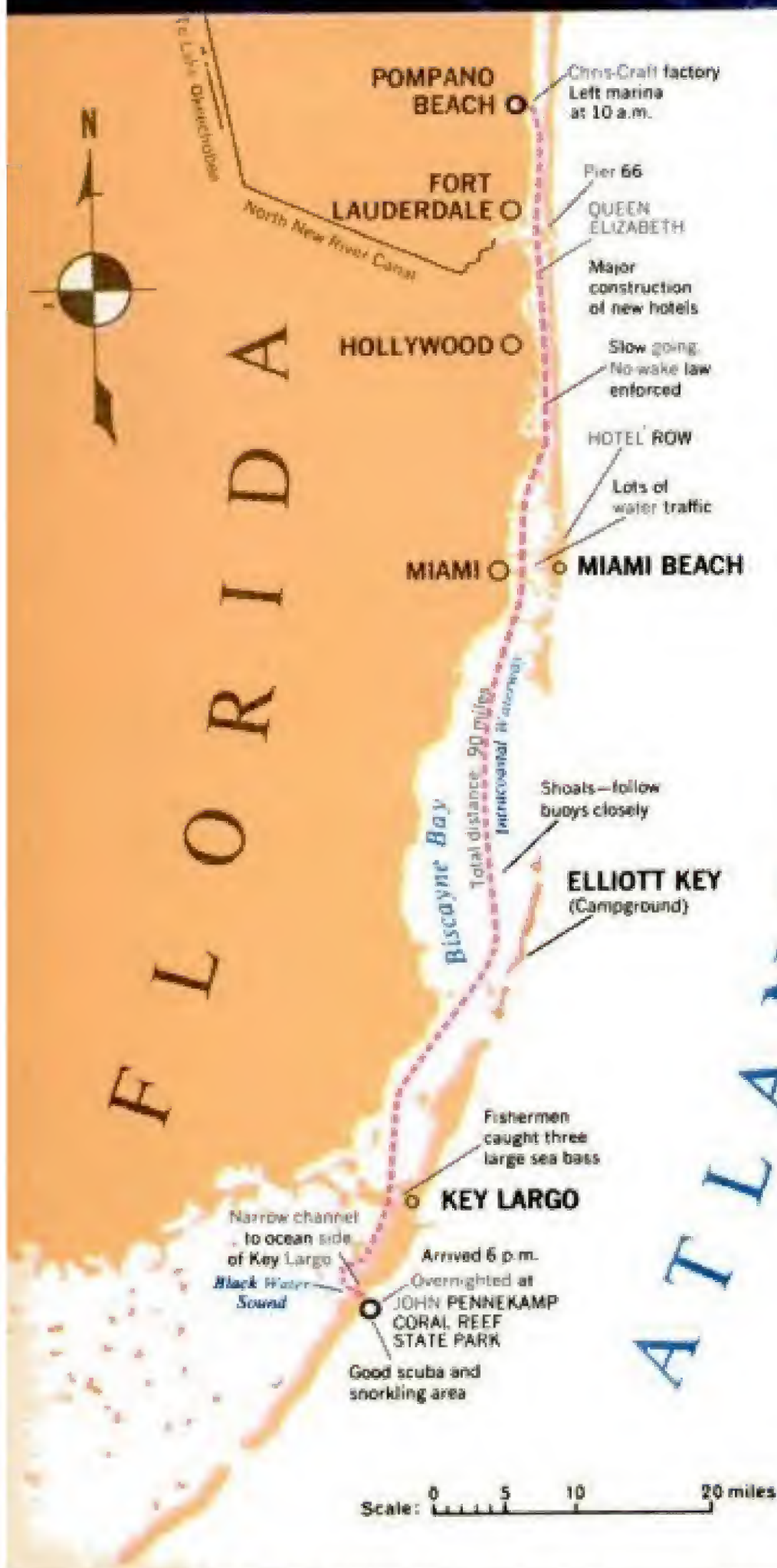
Sweet-shooting slingshot

Sailors on the USS Whitfield County make friends among Vietnamese children by shooting candy ashore on a super slingshot.



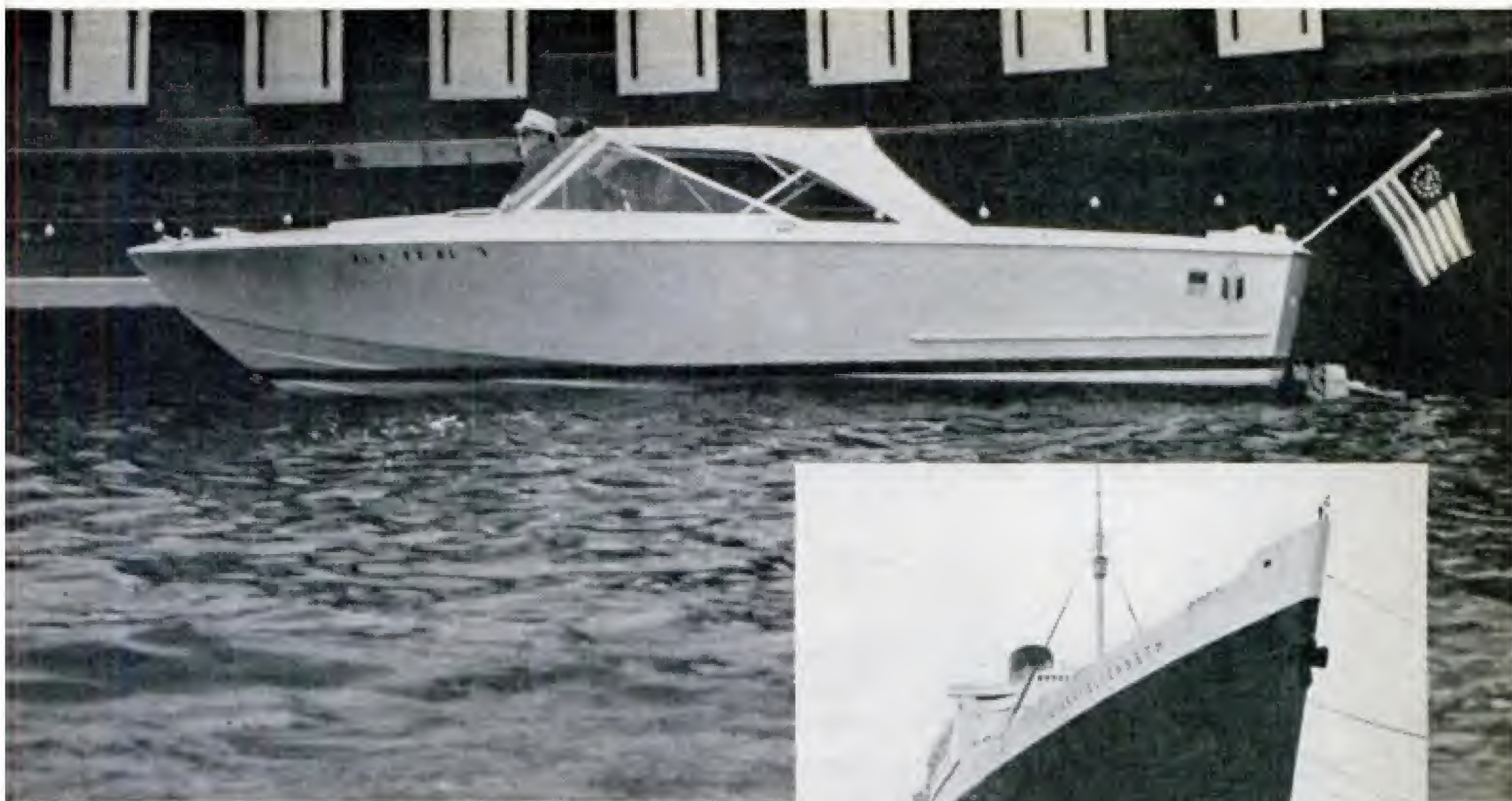
Lifesaving boat

A new British lifesaving boat that looks like an outrigger canoe has a rear deck on which victims can be placed for resuscitation.



PM Tests Chris-Craft's Wave-Piercing Lancer in the Florida Keys

This 23-foot, V-hull stern drive is a great boat to run the Intracoastal Waterway from Pompano Beach to Key Largo.



EVEN WITH TOP UP on Lancer, you can still get to the bow through the new center-swing windshield

By DAN FALES, Boating Editor

Photos by Burton McNeely

WITH 4000 POUNDS of boat you can smooth out the roughest of cruiser wakes like oil on water. This I'm finding out as I slowpoke down Florida's busiest waterway.

Local boatmen thought I was nuts to take a pleasure trip through this crowded section of the Intracoastal Waterway. But I chose it for sightseeing fun. I wanted to see the luxurious yachts, big hotels and million-dollar homes. So I climbed aboard a Chris-Craft 23-foot Lancer for a trip from Pompano Beach to Key Largo.

I planned this run as a two-day trip—a day to get to Largo, a day to get back. Besides, I wanted to see Florida's John Pennekamp Coral Reef State Park. This is the only state park that has 75 square miles of protected ocean waters. The park is 21 miles long and 3½ miles wide, all in the Atlantic Ocean off Key Largo. It's great diving and fishing grounds. When the tide's coming in and there's a west wind, the water's clear for scuba diving. The park is fa-

AUGUST 1969



THE QUEEN ELIZABETH, tied to her permanent dock on Intracoastal Waterway, still has an elegant look



FOLDOUT LOUNGE CHAIRS, each six feet long, show the amount of space available in the cockpit



BAIT WELL in the stern is a welcome asset for fishermen. The low engine cover lets you get to it



WAKE JUMPING is an easy maneuver for this 4000-pound boat. She doesn't clear the water by much which means quick recovery

mous for its variety of coral and species of tropical fish.

Starting down the waterway from Pompano Beach, I notice that there's plenty of legroom in Lancer around the driver's seat. Lancer is a big boat which permits a lot of open cockpit space. This is all-important for fishermen.

My Lancer is powered by a 150-hp stern-drive unit. You can get as options a 185-hp single or twin 150-hp drives with counter-rotating props. These power arrangements will enable Lancer to hit speeds of around 43 mph.

It is only half an hour out of Pompano that I spot the tall red and black stacks of the stately *Queen Elizabeth*. She's tied to a pier on the waterway near Fort Lauderdale. She looks very much out of place in this tropical setting.

Having seen the *Queen* often in New York Harbor, I must admit she looks now like an aging dowager relegated to dining at lunch counters.

On down the waterway I go, past hundreds of new homes under construction. If anyone says the Florida building boom is over, he hasn't been in this section. New homes and hotels are going up at a rapid pace.

So far, Lancer hasn't had a chance to show off. With all the no-wake laws along this section of waterway, I've hardly had her up on plane. But at low speeds I find no problems. Lancer handles like a lady. I've put up the canvas top for protection from the sun. The top is easy to handle. But I do find that the side windows are a little confining; they're good for keeping water out of the helmsman's seat, but you cannot lean on the "window sill" with an elbow as you do in a car.

Now I get a chance to open Lancer up as I

(Please turn to page 192)



LOW POSITION of the engine means more usable cockpit space in Lancer



WALK-THROUGH WINDSHIELD allows easy access to bow to tend the lines



THERE'S STORAGE SPACE in cockpit floor, also room for fish bins



Tiniest Bible

All 773,746 words of the Bible appear on this 1 5/16-inch-square piece of film. Edmund Scientific Co. says the words, reproduced by a new photochromic, micro-image technique, can be read with a 100x 'scope.



Framed commuters

Dividers between seats in the new station of the Paris Metro give commuters an unusual, framed view of one another.



Lightweight superstructure

The USS Conolly, first of 27 destroyer escorts with aluminum superstructures being built for the Navy, is launched at New Orleans. Aluminum makes her lighter and faster.

AUGUST 1969



Quick getaway

Nine men can make an emergency escape from the 320-foot level of the Apollo-Saturn V space vehicle in this cable car. The system, set up just before the Apollo 9 launch, takes the men 2000 feet from the rocket. At the end of the run, the men descend to the ground on a rope (lower photo).



Looks almost like fun

No drill hangs menacingly over the patient who reclines in the new Sirona 2000 dental chair. However, there's still a drill (naturally!), operated by a 350,000-rpm motor.

Olds 88: Eye-Catching Lines,

By **BILL HARTFORD**, Technical Auto Editor

"IT'S MY TYPE OF CAR," says a Michigan inventory analyst. That's why he bought a Delta 88. Another Michigan man, a salesman, says his reason was "habit—been buying Oldsmobiles since 1958." And a New York department store manager has the same reason, habit. A rural mail carrier in Ohio explains a little more fully: "I had three Oldsmobiles before and like their dependability."

Whether the Delta is their second, third, or, for a retired Florida couple, their twenty-third Oldsmobile, owners attribute their choice to good past experience. And what about first-time owners? For most the choice represents a step up, and interestingly, as many owners indicate, a step up from a Chevrolet: "Only \$200 more than a Chevy," relates a Louisiana stewardess. "Wanted to move up from a Chevy," says a New Jersey shop teacher. "Wanted a heavier car with more power than I had with the Chevy," says a retired Florida man. And a GM auto-

motive engineer in Michigan muses, "We kept our old Chevy too long; should have got the Olds sooner."

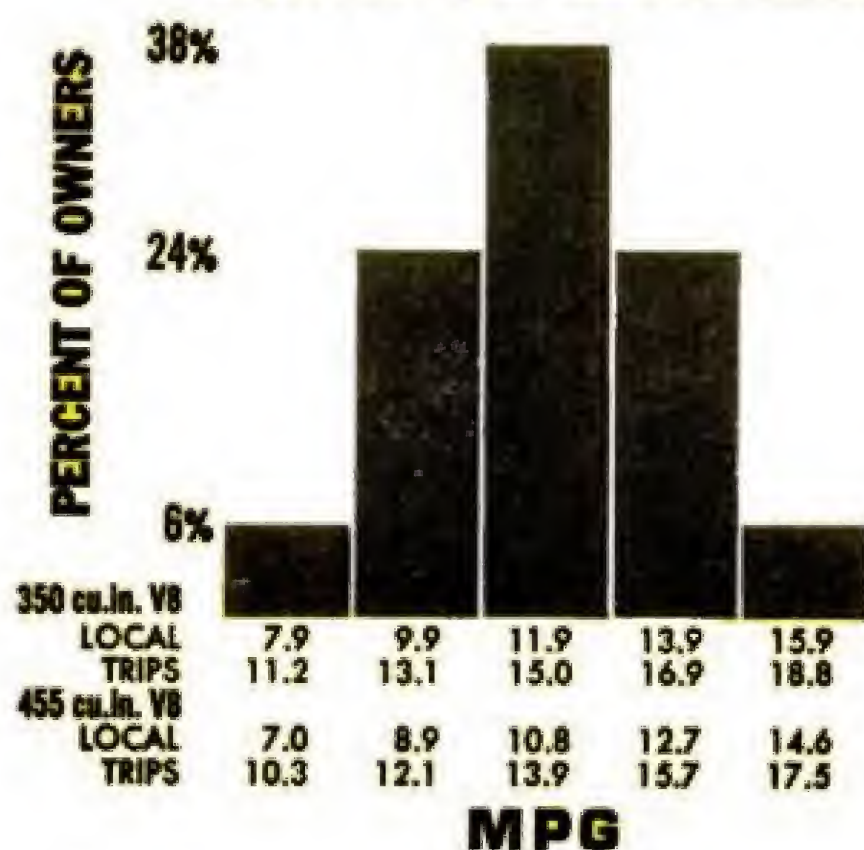
How do owners feel about their Delta once it's in the driveway? It's style that tops their list of likes (and is also the second biggest reason for buying the car). "Great looks, great handling," observes a stone company v.p. in Ohio. It's handling, in fact, that ties with smooth riding for second best attribute. Comfort, next best thing, rounds out what most impressed owners.

Very impressed is a South Carolina foreman: "Best driving car we've ever owned." A Georgia truck driver "tried a smaller car but didn't like the way it handled," so he bought his third Olds.

It's not all raves for the Delta, however. A Michigan carpenter may say, "I don't see how they could make a better car," but lots of owners say they can think of quite a few things and they tell you what to watch for.

Like a Michigan staff engineer, you may find the front floor too small. He

DELTA 88 FUEL MILEAGE CHART



TRUNK ROOM is only fair for size of car. Some owners complain about placement of the spare tire

900,000 Owner-Driven Miles

Neck-Stretching Visibility

Photos by Irv Dolin

wants a larger flat floorboard area: "I wear a size 14 shoe!" he says. Headroom may be a problem, as it is for a barber and hair stylist, also from Michigan. "My head hits the roof with my high hairdos," he says. "Matching seat-belt pairs" may be as big a problem to you as to an Ohio farmer. And be forewarned that the "cut" of the Delta steering wheel may, after "two or three hours of driving, tend to apply too much pressure to the joints on the palm side of your hand," as it does to an Army major in Georgia.

All isolated complaints, subjective and trivial if you will, but very real. After tabulating many such comments, there emerges a list of what bothers owners most. It's no coincidence that a salesman in Michigan and a dentist

DELTA IN THE DRIVEWAY: Owners bought 88s, first and foremost, because they've had good luck with Oldsmobiles. Style, ride, handling and comfort are tops; rear visibility, fuel economy get thumbs down





INSTRUMENT LAYOUT is smart and functional. Only exception is hard-to-see clock on the right side



PUSHBUTTON ASHTRAY is probably wasted engineering; nary an owner has anything to say about it



DELTA 88 INTERIORS are comfortable and spacious; legroom in two-door models is criticized, however

in Florida "have trouble seeing out the back window." So do a few hundred other owners. The poor rear visibility tops the list of what owners would like to see changed or improved.

A university professor in Wisconsin couldn't be more emphatic: "I don't like the shortened rear deck which leaves the rear invisible from the driver's position. Backing up is blind!! BAD!!" The point is, as an Illinois office manager says, "It's impossible to see rear of auto through rear window from driver's seat." Some owners, like the professor and this Illinois maintenance supervisor, blame the rear deck: "Trunk line doesn't allow you to see the tail end." Others blame the rear quarter panels, or the window: "Lower rear window or do something so you can see rear deck and fenders," says a Massachusetts sheet-metal worker. And a Michigan registered nurse says "I'd like to see where my car ends." Of course, this isn't unique to the Delta. Many other '69 car owners must dead-reckon their way into parking spots.

Delta 88 owners are also down on the number of miles they're getting per gallon of gas. As a Wisconsin manufacturing engineer says, "The price of gas goes up and the mileage goes down." He gets 10 mph around town and 15 on trips (winter driving) with his 350-cu.-in. V8. That's close to the average of 11.9 and 15 mpg. Of course, if that's the average, some owners are getting more



WORKMANSHIP is considered quite good by owners. On car photographed, however, the "88" marque is upside down and sloppy weld of spare tire retaining-rod plate left holes around it in trunk. Style is tops with owners but the few who have reservations refer to "swollen" fenders and sides vulnerable to dents

Summary of 1969 Oldsmobile Delta 88 Owners Reports*

Total miles driven: 909,954

Average miles per gallon:

350-cu.-in. V8, local driving... 11.9
long trips ... 15.0
435-cu.-in. V8, local driving... 10.8
long trips ... 13.9

Specific likes:

Style 37.5%
Ride 36.4
Handling 36.1
Comfort 30.0
Performance 18.9
Economy 5.4
Power 5.4

Specific dislikes:

Economy 17.2%
Rear visibility 10.5
Wind noise 9.5
Workmanship 7.7
Dealer service 3.9

What changes would you like?

Rear visibility 15.3%
Vent windows 10.3
Legroom 7.2
Workmanship 7.2
Trunk room 6.3
Gas mileage 5.8
Windshield wipers 4.0
Seat shape 3.6

Quality of materials 3.6

Engine:

350-cu.-in. V8 49.3%
455-cu.-in. V8 50.7

Model:

Holiday coupe 35.5%
Holiday sedan 30.7
Convertible 4.2
Town sedan 29.6

Transmission:

3-speed manual 0.7%
Automatic 99.3

Had any mechanical trouble?

No 74.0%
Yes 26.0

What kind of trouble?

Electrical 12.1%
Airconditioning 9.1
Carburetor 9.1
Brakes 7.6
Alternator 7.6
Power steering 7.6
Heat riser 7.6
Transmission 7.6

Dealer repair satisfactory?

Yes 78.4%
No 20.3

Why the Delta 88?

Past experience 38.4%
Style 25.2
Economy 20.2
Size 7.6
Reputation 5.0

Is the Delta 88 your only car?

Yes 52.5%
No 47.5

Other cars owned:

Chevrolet 26.0%
Oldsmobile 19.9
Ford 12.3
Volkswagen 11.0
Rambler 6.2

What options/accessories:

Power steering 67.9%
Power brakes 67.5
Radio 56.0
Airconditioning 53.0
Vinyl top 17.9
Rear defroster 14.2
Whitewall tires 13.4
Tilt-steering wheel 12.3
Clock 11.6

Age distribution of owners:

15-29 16.0%
30-49 49.3
50 plus 34.6

*Where applicable percentages may not equal 100 percent due to rounding and/or insufficient sample.

and some, like a New Hampshire traffic manager, are getting less: A whopping "five miles to the gallon," he says. And there's an anonymous owner who's overwrought at getting "five blocks to the gallon!"

Owners didn't come right out and praise workmanship, but the fact that it's low on the list of complaints indicates it must be quite good. One chap, a Georgia PR man, says his car has "squeaks, rattles, etc., etc., *ad nauseum*," but the great number of owners who had no complaints speaks louder for what they must think a solid piece of machinery. ★ ★ ★

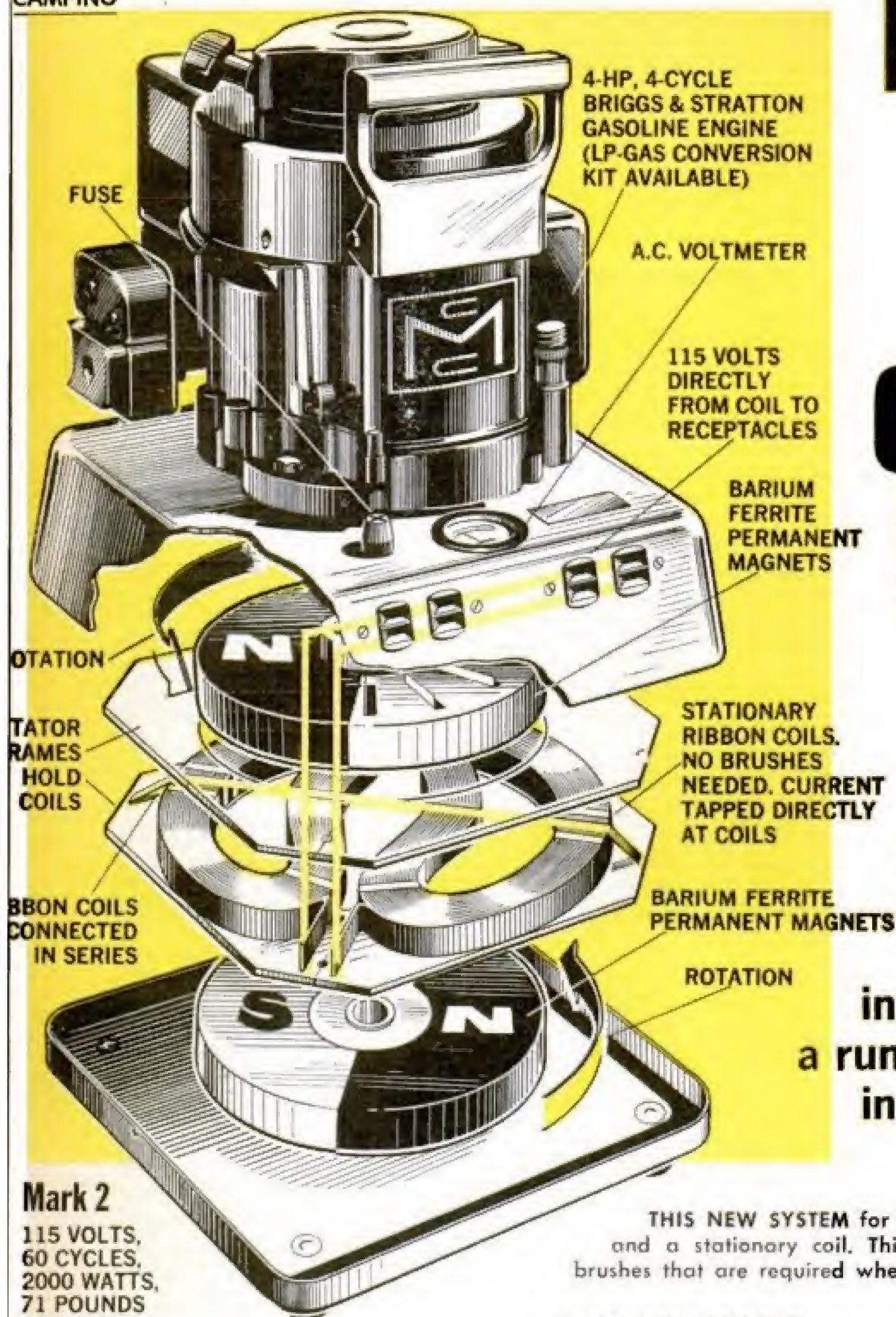


HARD CORNERING results in only moderate roll which is not at all objectionable to Delta owners

"HOP-UP" STYLE, however mild, is partially responsible for limited rear visibility complaints



Portable Power For Camping Comfort



Mark 2
115 VOLTS,
60 CYCLES,
2000 WATTS,
71 POUNDS

THIS NEW SYSTEM for power uses rotating magnets and a stationary coil. This eliminates a need for the brushes that are required when coil rotates around magnet

By V. LEE OERTLE

Light and sturdy electric generators are now packaged so you can have take-along power in your camper. Here's a rundown on what's new in the generator field.

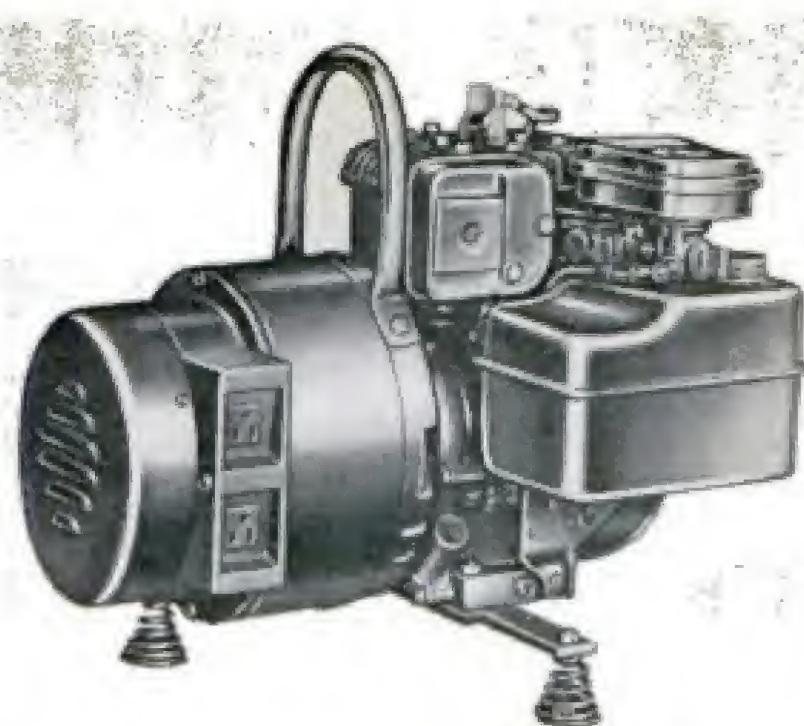
YOU'RE IN FOR A SURPRISE when you check into portable electric generators for your camper. Today's portable powerplants weigh about one-third less than those sold only 10 years ago. You'll find generators that run on gasoline, diesel fuel, LP gas and natural gas.

The new generators are quieter, too, thanks to improvements in silent mufflers. The vibration levels have been vastly reduced. In fact, on a recent road test my motor home had been fitted with a 5000-watt generator mounted in a compartment under the rear bed. Although the generator came on automatically every hour or two (to handle the airconditioner and refrigerator), it never disturbed my sleep. Considering the fact that a six-hp gasoline engine was spinning the generator I was amazed at the virtually noiseless operation. Frame vibrations, too, were held to a minimum with special damping pads.

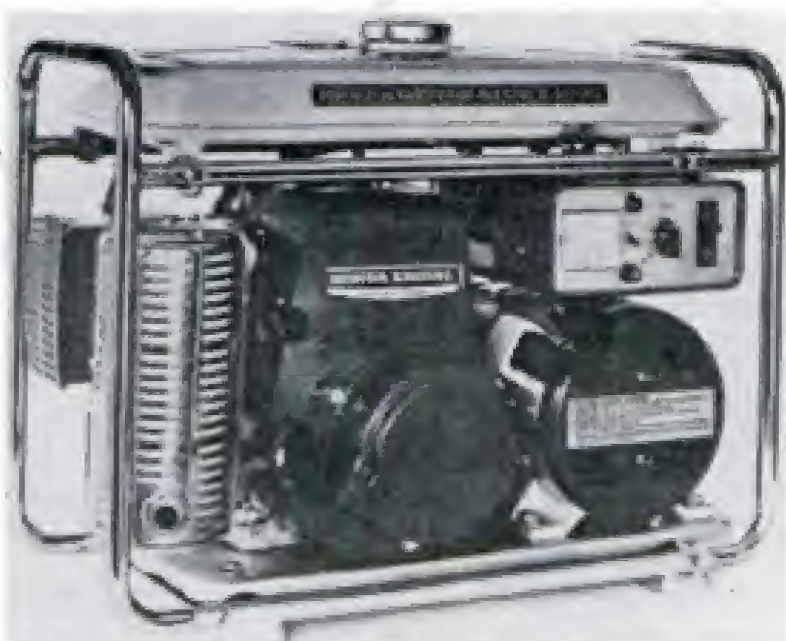
You'll find campers all across the country using portable electric power to drive



MERC-O-TRONIC rheostat-controlled portable generator has both a.c. receptacles and d.c. power tap



THIS WIN-POWER MODEL is rated at 2000 watts of 115-volt a.c. power. Entire package weighs 74 lbs.



NEW HONDA E-1000 weighs 136.7 lbs. This unit has battery-charging ability. It uses silent muffler



KOHLER 3000-WATT unit has a 7-hp engine. The entire engine and generator weigh about 158 pounds

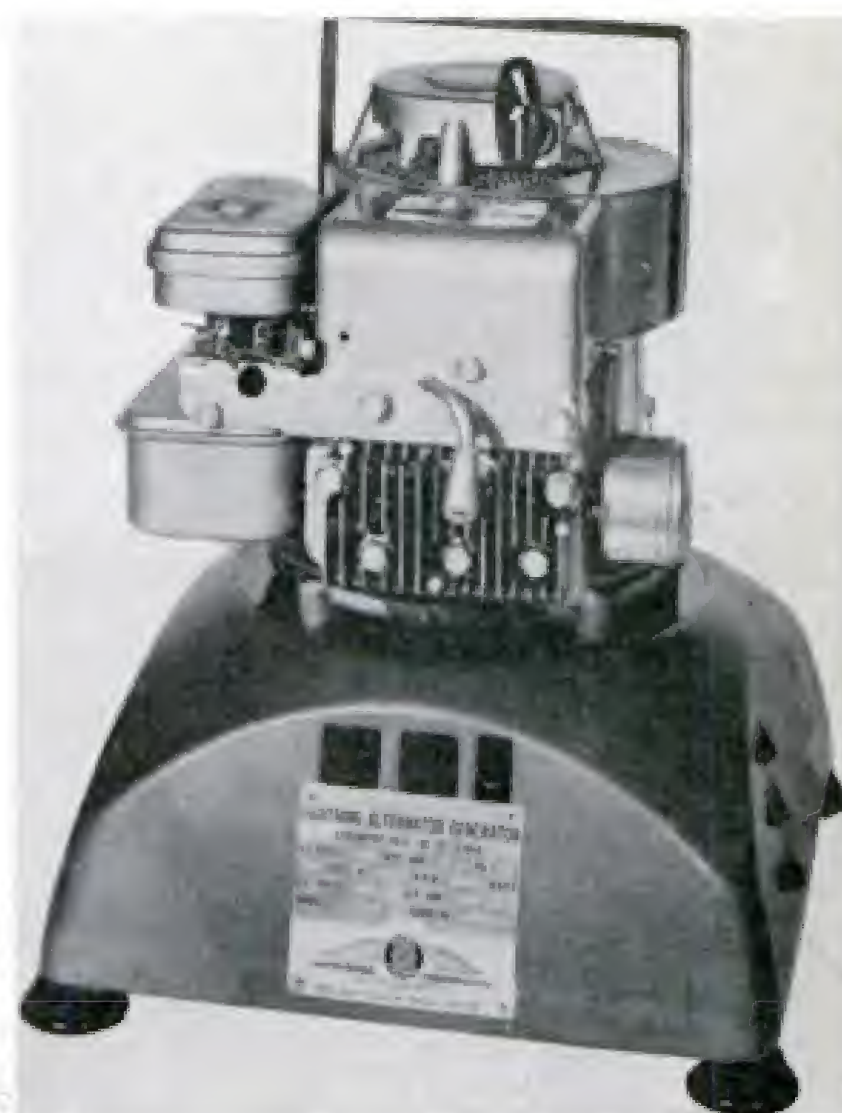
airconditioners, refrigerators, power tools, lights, fans, radios—anything that runs on 110-115 volts.

You can buy two general types of portable generators:

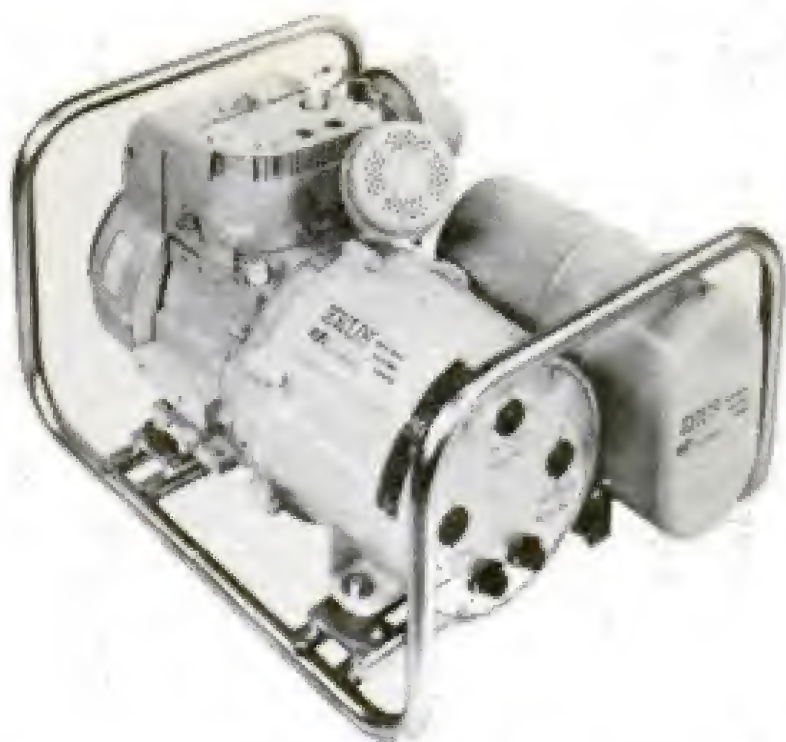
- Completely portable models ranging from 500 watts to about 2500 watts. Total weight of generators in this class ranges from less than 50 to about 150 pounds. In fact, the new McCulloch Mite-E-Lite puts out 1500 watts and weighs only 61 pounds.
- Models installed permanently on recreational vehicles. These begin at about 3500 watts and go to 5000 watts.

When you buy a generator, know its rated electrical output in watts and its gross weight. It should be light enough for a person to handle *alone*. This usually limits portable models to about 125 to 150 pounds. When I say handle, I refer to moving the powerplant from the storage bin to the ground, then back inside.

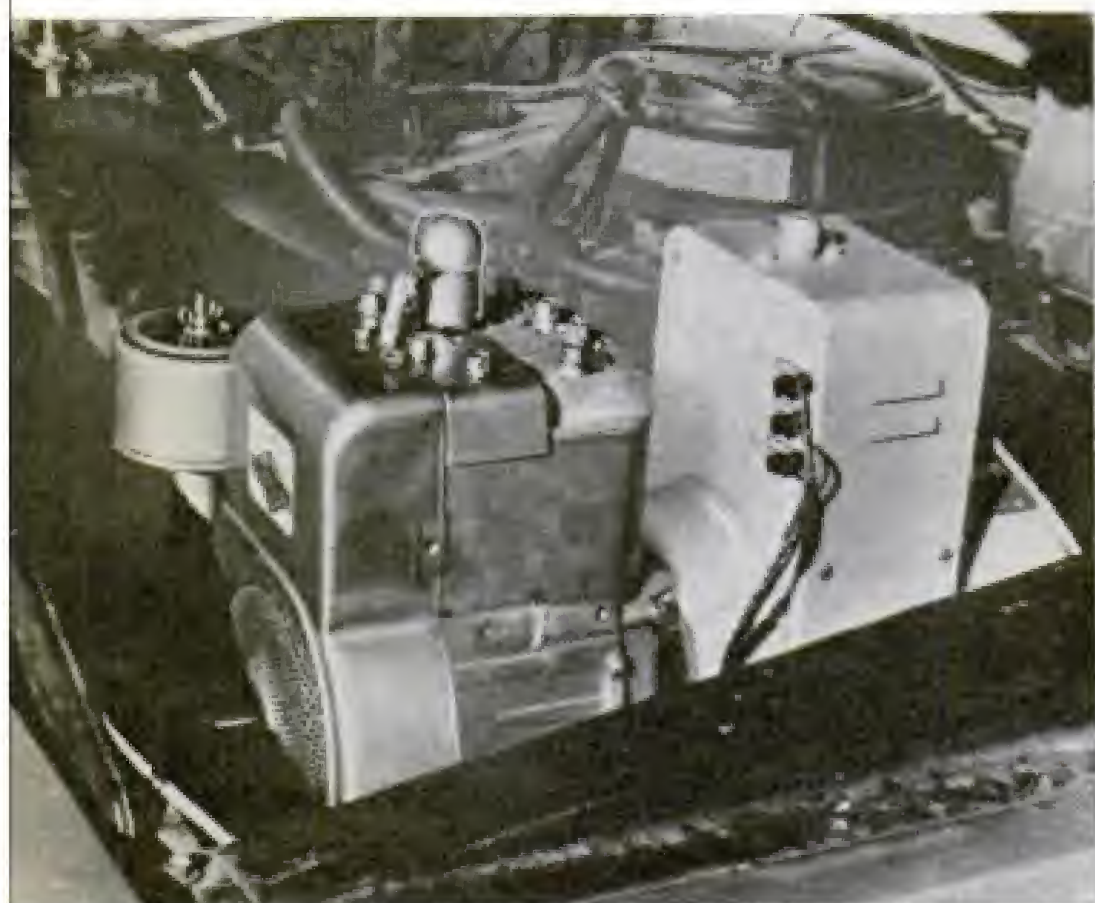
From personal experience, I know most buyers will eventually decide on a perma-



1250-WATT MERC-O-TRONIC operates with a revolving permanent-magnet field. No brushes are used



ZEUS 3000-WATT portable generator has three power receptables—one for 3000 watts, two for 1500 watts



UNDER THE HOOD of a pickup truck or other camp vehicle is a popular place to install generators



RALPH LIGHT PLANT is an insulated, self-contained 3000-watt unit. In a sealed metal cabinet, it has its own intake and exhaust vents

nent installation. But where to put it? Here are five suggestions:

1. *Under the hood of a pickup truck.* Surprisingly enough, there's plenty of room for a 1500-watt generator under most pickup hoods atop a fender well. One supplier charges \$450 for a complete installation in this location. That price covers a 1500-watt, 115-volt generator, mounting brackets and labor.

2. *In a storage compartment along the side of a coach.* All that's necessary is to remove gear and make sure that dimensions are adequate. The bin door can be used but it should have vent louvers added so that the gas engine can breathe. One new model (the Ralph Pur-Fected unit) is already built inside a metal cabinet. You simply cut out a section of coach wall and insert the packaged generator. It has its own hinged door, exhaust ports and intake vents.

3. *Mounted in place of the LP-gas tanks.* This is feasible when you remove the tanks in favor of all-electric operation.

4. *Attached to a front-mounted platform ahead of the car or truck radiator.* I don't like this arrangement because it blocks cooling air to the radiator. It also seems mighty vulnerable to collision damage.

5. *In a car trunk.* Yes, one trailer-tower installed a special platform inside his trunk and bolted the portable power-plant to it. At the campsite, he parks the car a short distance from the trailer, lifts the trunk lid, and fires up the gas engine on the generator. He uses a flexible metal exhaust pipe to rid the car trunk of carbon monoxide and heat. However, he must shut off the generator to move the car.

In the past, generators have been unpopular—especially with other campers. Here are some operating tips that show the trouble and suggest solutions.

● *Operating a gas-engine generator too close to other campers.* The generator owner should select a site on the edge of a camping area, when possible.

● *Operating a generator on the ground without placing*

PORTABLE GENERATORS FOR RECREATIONAL VEHICLES

Manufacturer	Power in watts	Approx. weight	Price range
HOMELITE	500 to 5000	38 to 225 lbs.	\$260 to \$895
HONDA	300 to 1000	39 to 136 lbs.	\$144 to \$251
KOHLER	500 to 10,000	95 lbs. and up	\$325 to \$1495
LINCOLN	3500 to 5000	347 to 701 lbs.	\$355 to \$740
MITE-E-LITE	1500 to 3000	61 to 165 lbs.	\$320 to \$820
MERC-O-TRONIC	1250 to 4000	70 to 194 lbs.	(Prices NA)*
ONAN	500 to 10,000	82 to 305 lbs.	(Prices NA)*
RALPH LIGHT PLANTS	1500 to 4100	94 to 170 lbs.	\$350 to \$650
WIN-POWER	2000 to 20,000	74 to 627 lbs.	\$305 to \$1145
ZEUS	500 to 3000	46 to 215 lbs.	(Prices NA)*

*Because of variations in engine types, generator types, options, and shipping charges, some companies declined to offer retail prices. Hence, NA means Not Announced. Contact each company for specific details.

All models above rated at 60-cycle, 115-volts a.c.

a cardboard deflector shield around it. Such a shield is easy to make from a cardboard box. Just prop up the cardboard deflectors in such a way that the sound of the engine will be aimed away from camp.

Placement of the generator also counts. For instance, it'll make the most noise sitting on pavement or other hard surfaces—the least noise when it's resting on sand, loose dirt or an absorbent pad.

● *Operating a generator continuously.* Never run your generator after 9:00 o'clock in the evening if the campground is crowded. If it's necessary to operate the unit almost continuously on occasion (during spells of hot weather, for example) make sure that the compartment door carries extra insulation. It is even more important that you are parked downwind of most other campers.

The newest portable generators are so quiet that from 50 feet away they sound like an electric fan. That isn't objectionable to most people. The noise level is already down to a gentle humming inside completely sealed compartments, such as the Ralph unit, and the Onan fiberglass-housed powerplant.

The secret in making a good purchase of an electric generator is to buy one large enough for your average requirements. Picking the right model is merely a matter of listing your personal power demands.

Appliances in the following list are the most popular with campers. Pick those items you use most frequently and total the wattage. Remember, you won't run all appliances at the same time. For example, the refrigerator is on much of the time. But a toaster, electric blanket, vacuum cleaner or power tool is used only intermittently.

Item	Wattage
Refrigerator	250-500
Electric fan	25-75
Radio	20-200
Television set	150-400
110-volt bulbs (10)	1000
Airconditioner	3500
Electric iron	500-1200
Toaster	1000
Water heater	2500-4000
Hotplate (per burner)	800-1000
Battery charger	200-300
Vacuum cleaner	200-800

Once you know the amount of output you need, pick a generator that runs on your choice of fuel. Depending on your need, you can order a generator powered by an engine that runs on gasoline, diesel fuel, LP gas, natural gas, or a combination of gasoline or natural gas. Yes, you can get a new Onan with a natural gas-gasoline carburetor which will handle *either* type of fuel. ★★★



One-man U-boat

A new, one-man fiberglass submarine was recently demonstrated in Munich. The sub, powered by two electric motors, can dive to about 150 feet and remain four or five hours.



Need people? Build 'em!

Hiring 50,000 extras to fill the stands for filming scenes in *The Games* would have been prohibitively costly, so the film company made its crowd by molding plastic figures.



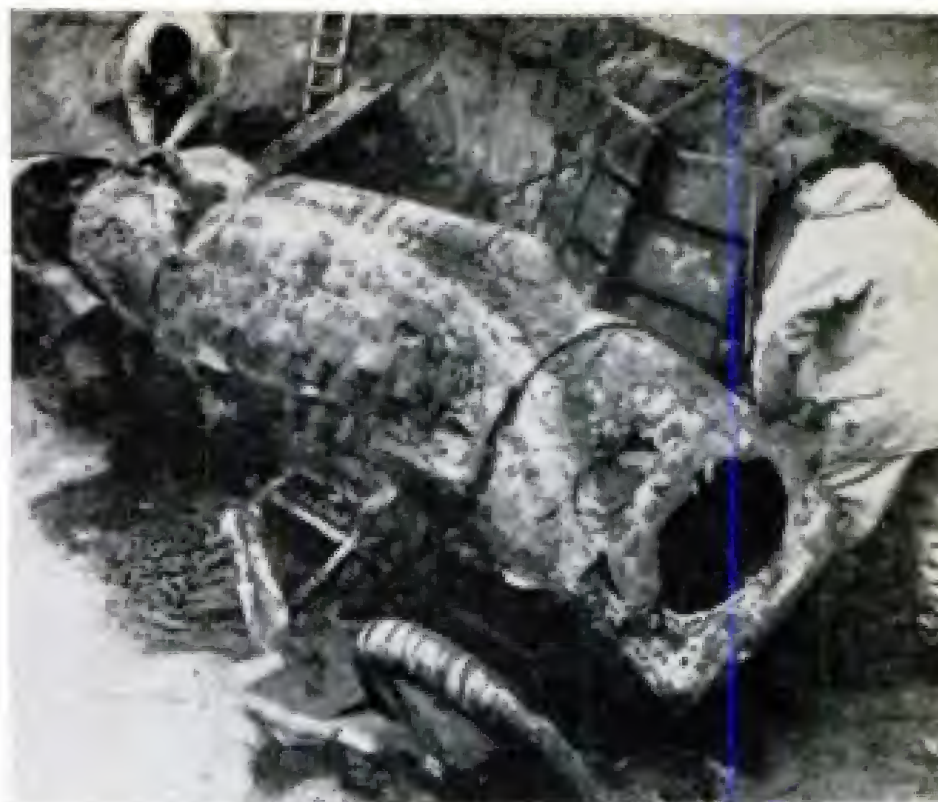
Underwater escape suit

Shooting out of the water (above) is a petty officer demonstrating a new submarine escape suit used by the British Navy. To escape from a sunken sub, a crewman puts on the suit, inflates it with air and shoots to the surface. The demonstration was conducted from a submarine 150 feet down.



Shape up, mate

The suit at right is the same as the one at left, except that the Danish Navy frogman inside is demonstrating how the suit can be blown up with air from pressure bottles so that it turns into a buoyant lifejacket.



Resurrected machine

Being lifted from the grave where it was buried in 1927 is the racing car in which Parry Thomas was killed on a speed-record attempt. Friends interred the car as a mark of respect. The 400-hp racer will be restored.



Hitchhiking buggy

Bonanza's new Minibuggy is designed to fit inside a station wagon so it can be carried easily to driving sites. A 15-hp engine moves the 300-pound buggy up to 40 mph.



Clip-on camper

With a Caraboot camping outfit added, this Mini Traveller gains a sleeping room for two on top and sitting room and kitchen behind. The bedroom roof converts to a rowing dinghy.

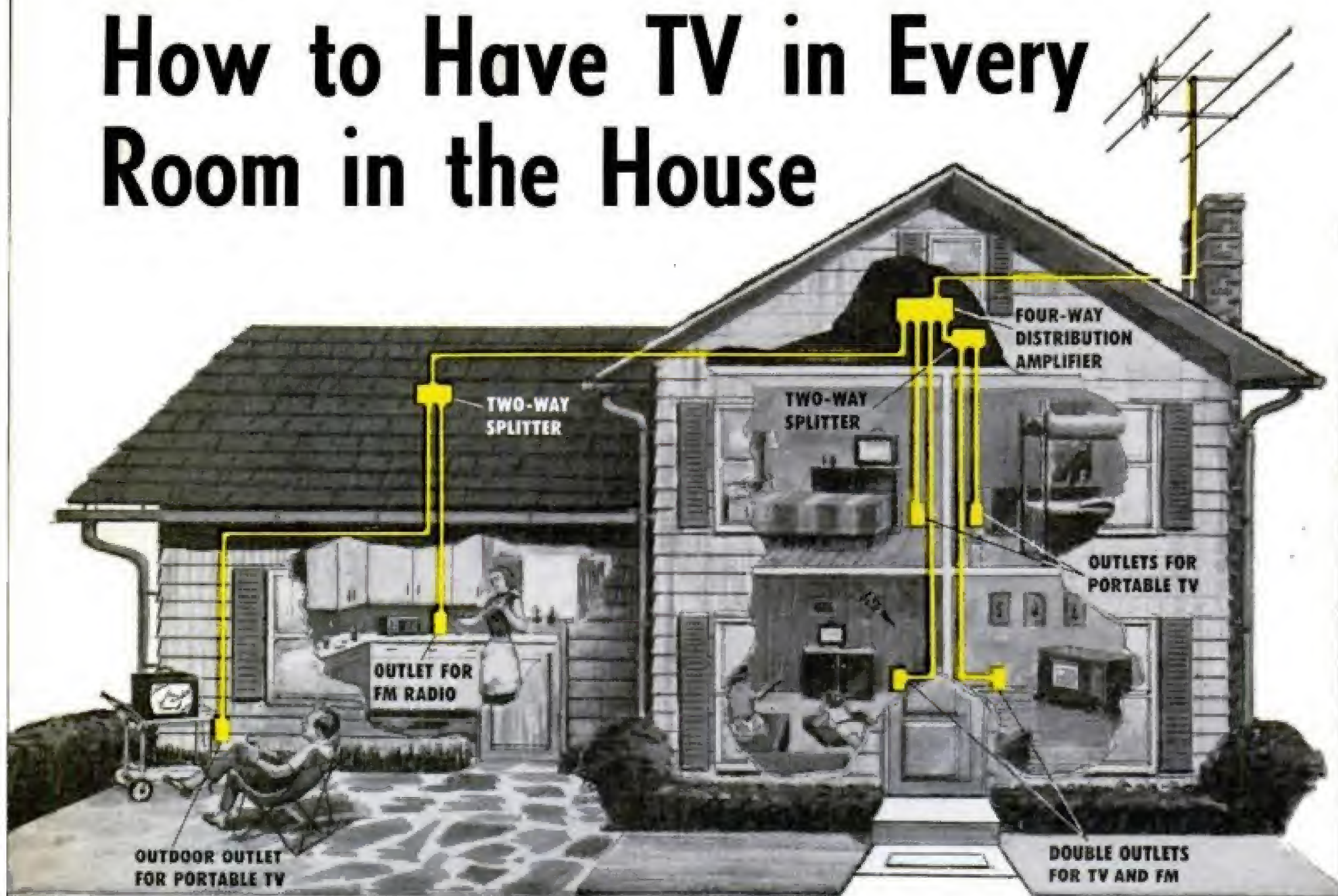


It's mine, all mine

The technical center of Medusa Portland Cement Co. is located in an abandoned limestone mine at Wampum, Pa. Maintaining a comfortable air temperature in the 40-room center is easy; the mine stays a constant 54° F. and needs only heat and dehumidification.



How to Have TV in Every Room in the House



A master antenna system will let you operate two or more sets simultaneously in different locations and give you extra outlets anywhere you want them. Here's how to work out a plan to suit you and your home

By FOREST H. BELT

Photos by Robert D. Borst

YOU PROBABLY OWN more than one TV set or soon will. It's estimated that 18 million homes already have two or more sets, with the number increasing every day. New color sets are coming along to bump the old black-and-white into a playroom or den. Often there's a third, portable set that's lugged around from room to room.

If you're operating these extra sets without a rooftop antenna, chances are you're not getting as good reception as you could. You don't have to install a separate antenna for each set, though. The answer is MATV—Master Antenna Television. This is a system that lets you connect two, four, eight or even more TV sets to a single antenna without any loss of signal or interference between the sets.

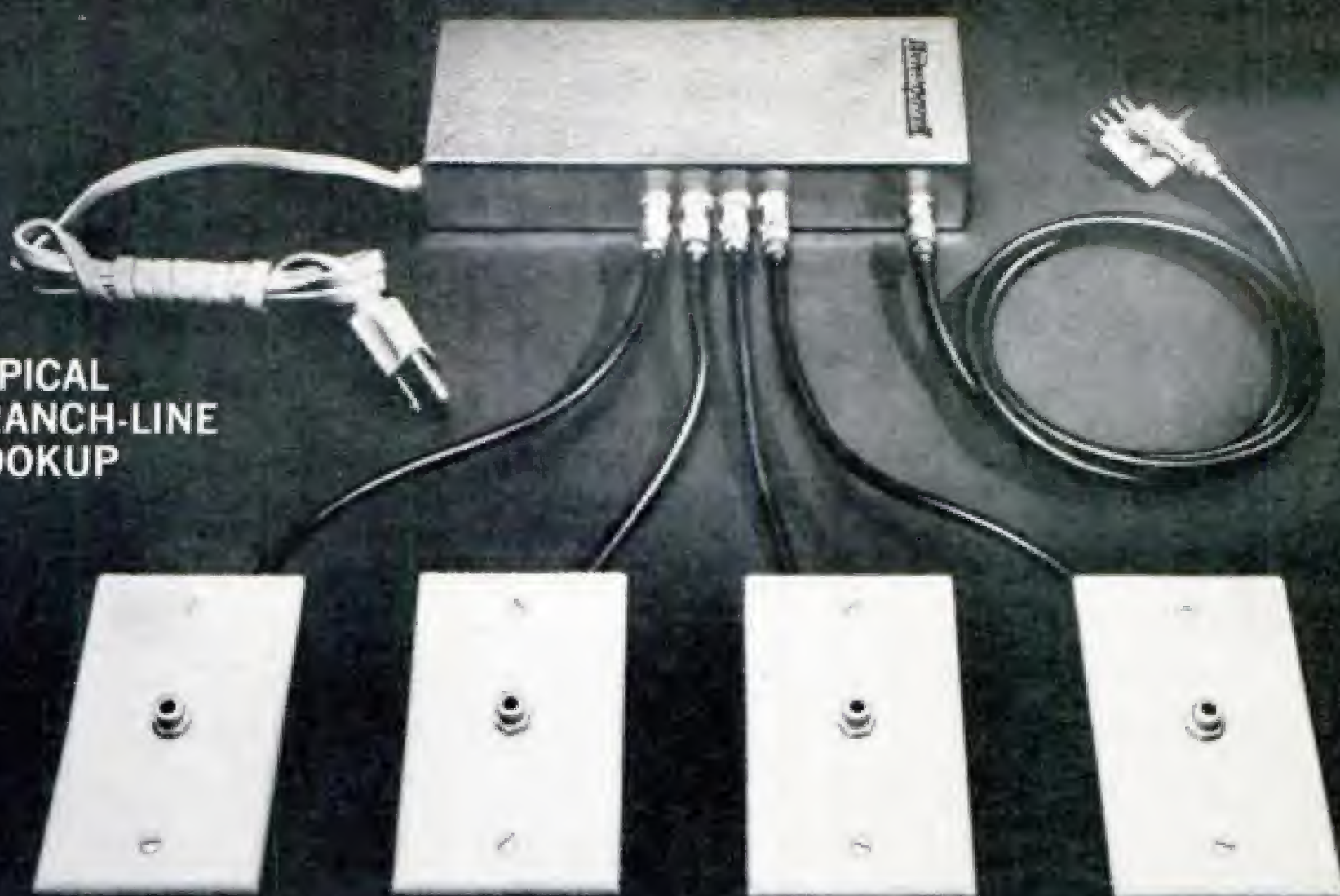
Apartment buildings use MATV sys-

tems to feed antenna signals to hundreds of sets. You can install a miniature version in your own home. You need only a few pieces of equipment and some connecting cable. Not only will such a system feed several sets simultaneously, but it will let you watch TV anywhere you want. You can have an antenna outlet in every room—even outdoors. Connecting a TV is as simple as plugging a lamp into a wall socket. You can enjoy the luxury of watching the Late Show in bed or a ball game out on the patio while relaxing in the sun. When a youngster wants to see something, he can pack a portable off to his own room and leave you undisturbed.

Because FM frequencies fall within the TV range, they can be picked off the same antenna. A MATV system makes it possible to split the FM and TV signals so

WHAT YOU NEED FOR A MASTER ANTENNA SYSTEM

**TYPICAL
BRANCH-LINE
HOOKUP**



YOU CAN FEED FOUR TV SETS simultaneously from a single antenna with a setup like this. The amplifier at top connects to the antenna and has four

outlet terminals for running branch lines to wall outlets in four different locations. Fifth terminal at right is for the input line from the antenna



DISTRIBUTION AMPLIFIERS

BASICALLY SIMILAR, distribution amplifiers are available in a variety of makes and models. Those here are all four-way types designed to feed four

TV outlets. Makers are, from left to right, Finco, Winegard, JFD and Jerrold. Amplifiers are powered by house current, need a nearby outlet to plug into

**TV AND
FM WALL
OUTLETS**



DESIGNED TO FIT standard electrical wall boxes, antenna outlets come in several styles to suit different needs. One at left provides single 75-ohm tap for a TV set. Combination outlet at center has

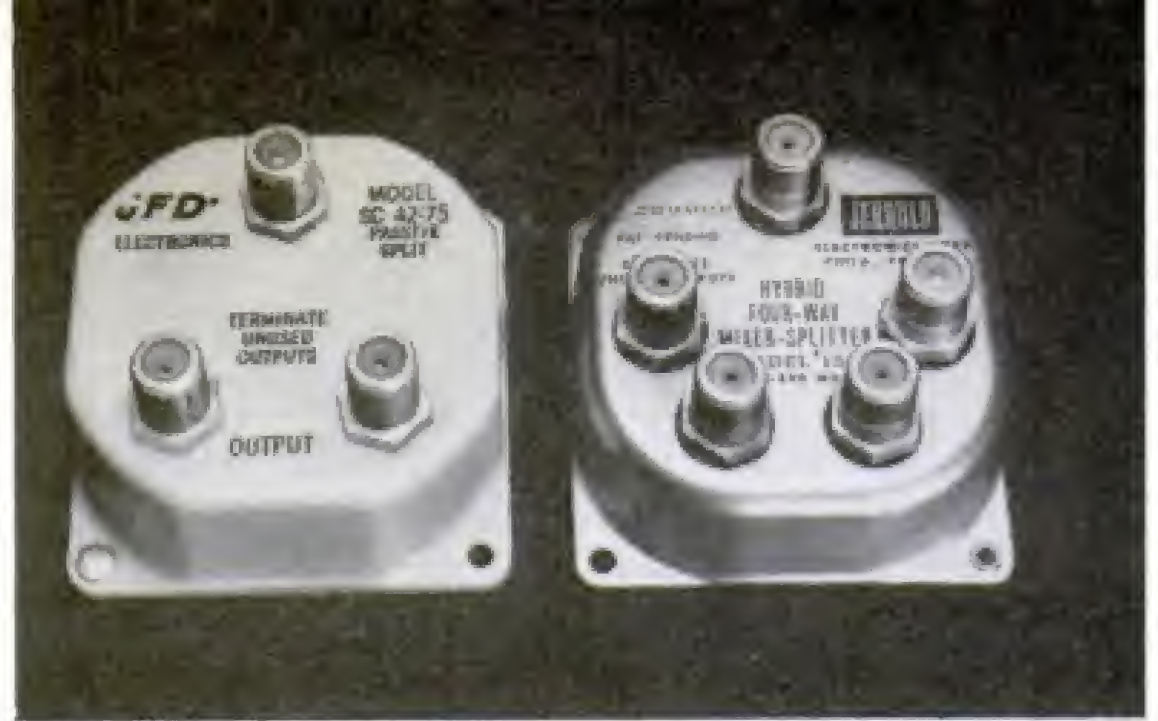
a 75-ohm tap for TV and 300-ohm terminals for an FM radio. At right is a dual outlet with one tap for either FM radio or TV and a multi-conductor receptacle for plugging in an antenna rotor control



INSIDES OF A TYPICAL amplified coupler look like a miniature radio chassis. This transistorized Finco model has one input at the top for antenna lead and four outputs at the bottom for branch lines

you can feed them to different sets. FM reception is often improved, especially on stereo, because the signal, in addition to being split off, is given a boost in power. Color TV, which also needs a powerful signal, frequently benefits in the same way from the installation of a MATV system.

Most TV-antenna manufacturers and electronic-supply houses sell the parts for a MATV system. You can have all sorts of hookups. The first thing to decide is how many outlets you're going to need. If you just want to connect two TV sets to one antenna, you can buy what is called a passive splitter. This connects to your antenna's downlead and provides two outlets for running branch lines to two receivers. It's called "passive" because it



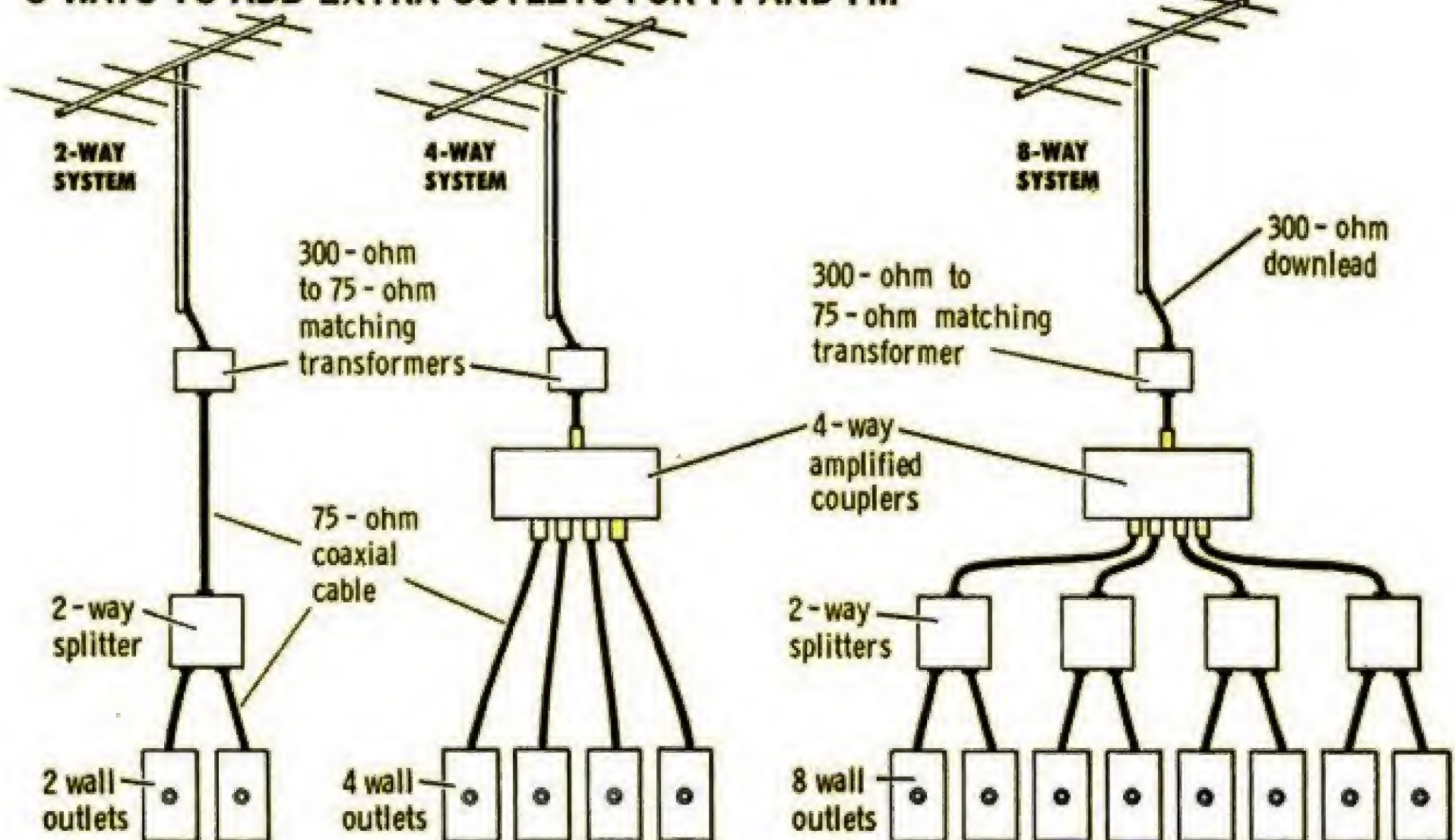
PASSIVE SPLITTERS divide antenna signals, but add no amplification. They can be combined with amplifiers to add more branch lines. Left to right above are two-way JFD model and four-way Jerrold

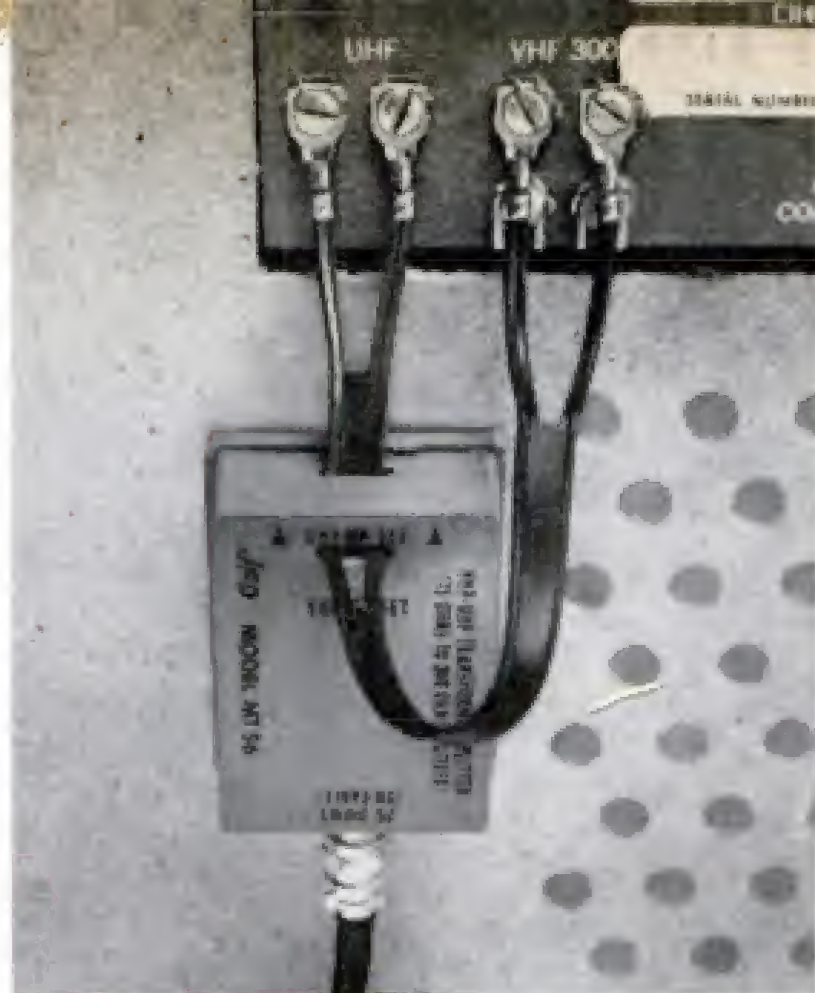
merely isolates the receivers; it doesn't boost or amplify the TV signal. In fact, it introduces a slight loss as it divides the signal in two.

A passive splitter is all right if you have a sensitive antenna or live in a strong signal area where the loss won't be noticed. If your signal is questionable or you want a whole string of outlets throughout the house, you're better off with an amplified coupler, also known as a distribution amplifier. This contains a miniature electronic amplifier that gives the signal a boost to overcome the loss of splitting. In some cases, the signal reaching the set is actually stronger than when it arrived at the antenna.

Distribution amplifiers come in different models depending on the number of out-

3 WAYS TO ADD EXTRA OUTLETS FOR TV AND FM





MATCHING TRANSFORMERS like this JFD model mount on back of TV and convert 75-ohm antenna-line impedance to 300 ohms for receiver. They also split VHF and UHF signals



HANDY ACCESSORIES for installing a master antenna system are shown above. At left is a short 75-ohm coaxial cable for hooking TV set to a wall outlet. It comes with connectors attached and a matching transformer. At center is a 100-foot roll of coaxial cable with an antenna-matching transformer on one end and set-matching transformer on the other. At right is a separate kit of matching transformers without cable. Accessories are made by Winegard

lets you want. One of the most common types for home use is a four-way coupler that gives you connections for four branch lines. If you need more outlets, you can install a splitter in each branch line, dividing it in two and giving you a total of eight lines. Or you can connect additional amplifiers to the first amplifier, providing even more capacity.

Splitters and amplifiers can be combined in almost endless arrangements to give you the number of outlets you want. The accompanying diagram shows a few typical arrangements.

The second decision to make is on the type of connecting cable to use. You have a choice between familiar flat, 300-ohm twinlead and newer 75-ohm round coaxial cable. Coaxial cable is more expensive, but is less bothered by electrical interference because it is surrounded by shielding. It also is more rugged and longer lasting. It does however, require a sensitive antenna and a powerful distribution amplifier as it introduces more signal loss than 300-ohm twinlead. Its advantage is that you can run it anywhere, even along

(Please turn to page 200)

BUYER'S GUIDE TO MULTI-SET TV ANTENNA SYSTEMS

Models listed are for 75-ohm systems. 300-ohm equivalents are available.

Maker	4-Way Amplified Couplers	2-Way Passive Splitters	Antenna-Matching Transformers** (300-75 ohm)	Set-Matching Transformers (Split UHF and VHF)	Cable Kits With Connectors	Single Wall Outlets (For TV only)	Double Wall Outlets (For TV & FM)
Blonder-Tongue*	DA4 U/V	A102 U/V	(Not needed)	4539		3649	3650
Finco (Finney Co.)	M-118	M-204	7512-A	7520	CX-283 (50, 75, 100 ft.)	M309	M304
JFD Electronics	PC4782-CD	SC42-75	(Included with PC4782-CD)	MT56	CS-81 (10, 50, 75, 100 ft.)	TT-7575	TF-3030
Jerrold	TAC-4	1596	CAT-2	FSX-1314	CAC (50, 75, 100 ft.)	UT-18	UT-13
Winegard	BC-782	CS-775	T-283M	MSJ5	CL-50, CL-75, CL-100 (50, 75, 100 ft.)	T-77	T-32

*300-ohm system only. **Not needed with 75-ohm antenna.

Manufacturers' Addresses: Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark, N.J. 07102.
 Finco Co., 34 W. Interstate St., Bedford, Ohio 44014.
 JFD Electronics Co., 15th Ave. at 62nd St., Brooklyn, N.Y. 11219.
 Jerrold Electronics Corp., 401 Walnut St., Philadelphia, Pa. 19105.
 Winegard Co., 3000 Kirkwood St., Burlington, Iowa 52601.



Docking help for supertankers

Skippers of giant new ships will get help in docking from Edo Western's "Navtrack" Docking System. Bouncing sonar signals off the bottom, the gear gives a readout in feet per minute (left) of the ship's fore-and-aft speed and of the lateral movement of bow and stern. Figures indicate actual over-the-bottom speeds.



British-French rocket seeks out radar targets

Martel, a rocket developed by the British and French, seeks out radar stations and destroys them. At left, a rocket leaves a Mirage jet fighter; at right is the destroyed target.



Airborne beads clean leather

Valuable Indian leatherwork in the Smithsonian Institution is safely and effectively cleaned by tiny glass beads propelled by an 80-p.s.i. air blast through this nozzle.

One for the road

Fixed to a rod that is inserted into a car's lighter socket, the Paluxette coffeemaker brews two cups in 15 minutes—then pivots on the rod for easy pouring.



Desert flame thrower

When weeds began to take over the irrigation canals of the Wellton-Mohawk Irrigation Div. of Yuma, Ariz., shop workers put together this flame thrower to fight back. The device mixes diesel fuel and air to produce a flame that keeps canal banks free of weeds.



The Earth in fiberglass

Newly charted undersea terrain is shown in relief on the 6-foot, 3-inch fiberglass globe at the American Museum of Natural History.

AUGUST 1969



Custom built for backs

A driver can tailor his car seat for best back support with "Lumback," which consists of two pillows that cling to a perforated plastic cloth on the back of the car seat.



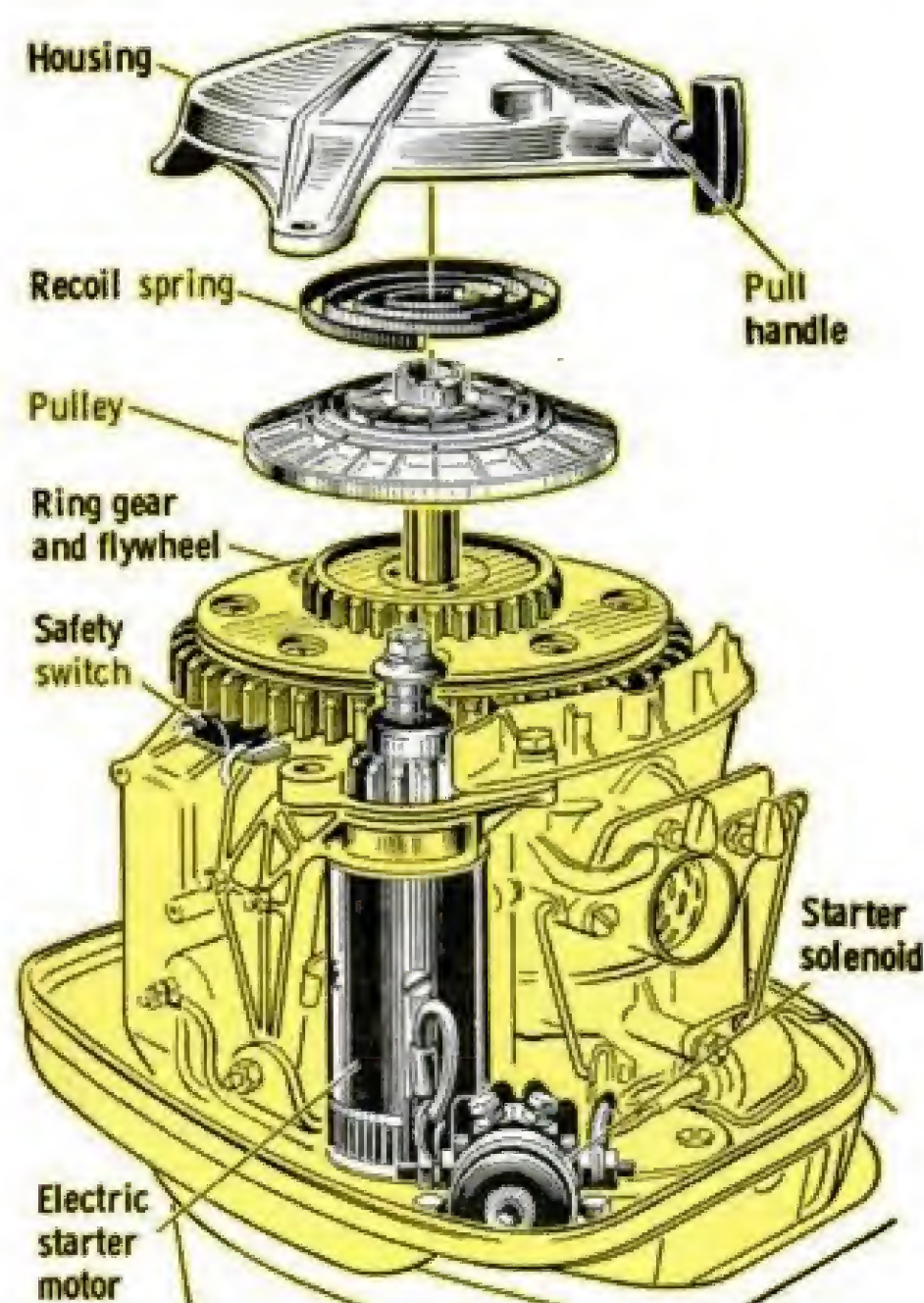
Start of a quasar-watcher

Under construction in Germany is one of the world's largest radiotelescopes. It will be used for observing quasars.

How to Check Out Your

Electric-start and manual-start are the easiest systems in your motor to troubleshoot and the simplest to repair.

By HENRY B. NOTROM



UPPER THREE PARTS are used in manual-start systems, the lower parts are used in electric-start systems.

1. REMOVE PAWLS from starter housing (some are shown in lower part of housing). Check them for wear



OUTBOARD MOTORS have manual starters or electric starters, or both. We'll explain how to repair a manual starter first; then we'll talk about electrics.

Most outboard motors employ a manual starter of the type similar to that shown in the drawing (left).

Manual starters are extremely reliable. Most will last the life of an outboard motor if treated properly. The commonest problem is a damaged rewind spring. This happens most often when the operator steps back and gives the rope a yank that

This is the second of five articles that will give you a ready-made service manual for your one and two-cylinder outboard motors. Clip and save them.

exceeds its length. It's also possible for the rope to break, but this isn't as common as some people believe. Starter ropes are exceedingly strong.

You'll need a spring rewind tool to repair a manual starter. It costs about \$5. You'll also need a rope-threading tool to pull the rope through the handle. It costs a few cents.

You must be very careful in handling

2. REMOVE SPINDLE from housing. Hold housing and pulley together until ready to separate the two



Starting System



3. DROP ASSEMBLY. Step back quickly to avoid being struck by rewind spring located in the assembly

manual starter repairs. The rewind spring is under great tension and could cause serious injury if allowed to fly loose. Wear safety glasses. Also make sure you hold the starter housing and pulley parts firmly together once the connecting spindle has been removed. This will prevent the rewind spring from slipping loose.

Here is how to repair a manual starter:

1. Remove the attaching screws holding the starter housing to the powerhead and lift the housing from place.

2. Remove the pawl retainers, pawls, spindle, and friction ring (Photos 1 and 2). Examine the pawls. If worn, replace. Note how parts come out of the housing so that replacement will be simplified.

3. Now, drop the starter, bottom side down, on the floor (Photo 3). This will separate the housing, pulley and spring (Photo 4).

5. REWIND TOOL is needed to reassemble spring into pulley. Crank until spring is tight. Insert dowel



4. THE THREE MANUAL-START PARTS can be worked on. If there's an "S" in the spring, untwist and reuse

4. If it isn't broken, pull the starter rope out far enough for you to tie a slipknot. Then pry open the rope anchor and remove the rope.

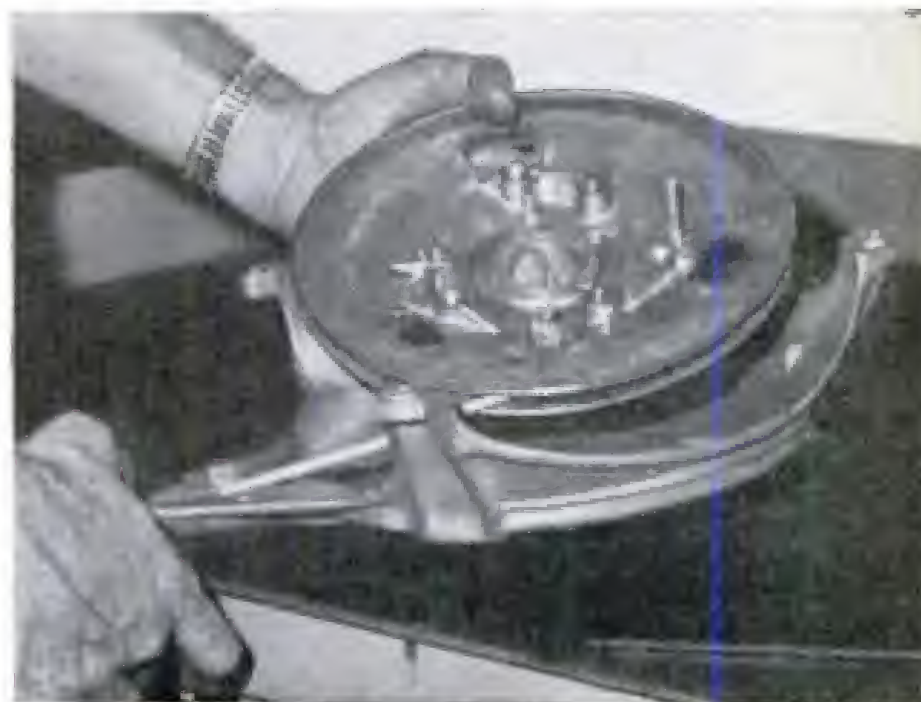
5. Spread some Type A lubricant on the end of the rope to allow easy removal of the handle.

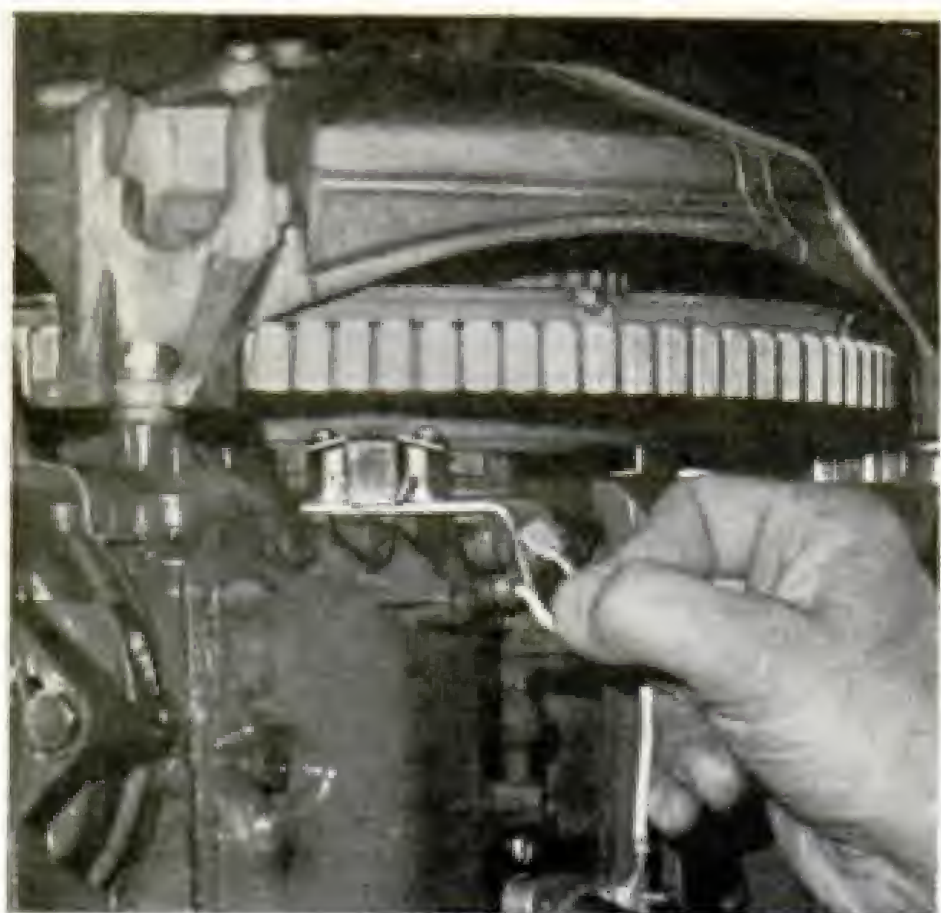
6. Replace a damaged starter rope or rewind spring.

7. To put the starter back together, insert the base plate of the rewind tool into a vise. Place the starter pulley in position on the base plate, making sure that the center pin fits into the center loop of the spring. Insert the tool's bushing and handle into the pulley and base plate, and crank up the rewind spring (Photo 5).

8. When the spring is tight, release it slowly until you're able to slide the dowel pin through the hole in the pulley and into the spring loop. This pin holds the spring

6. DOWEL PIN, inserted in pulley, holds spring in place until pulley is fitted into starter housing





7. GROUNDING SAFETY-SWITCH WIRE should make motor operate. If not, the switch could be bad

in place while you reassemble the starter.

9. Lubricate the spring with some Type A grease and place the pulley and spring into the starter housing, making sure that the outside spring loop is on top of its stud in the housing (Photo 6). Press down so the stud forces the dowel pin out.

10. Tie a slipknot into the rope to keep it from winding up. Now, reassemble the starter.

11. A tough job is usually that of putting the handle back on the rope. If the rope is too stiff, use plenty of lubricant.

Next is the repair of an electric starting system which consists of a storage battery, starter motor, starter solenoid, safety switch and cables. This is a very easy system to troubleshoot, and it's one of the simplest in your entire outboard engine to repair.

To do the work, you should be equipped

with a battery hydrometer to test battery condition and a voltmeter to check the voltage drop of the starter motor. The voltmeter should be graduated in tenths of a volt, but it doesn't have to be an elaborate instrument.

You will need a "growler" for testing starter-motor components if the motor has to be disassembled. However, I wouldn't advise buying this instrument, which costs about \$30, for the rare time you might need it. First, check your local rental center—A to Z, or the like—to see if you can rent one. If not, try to borrow one from the gas station with which you do business. Growler testing takes only two minutes.

If you can't borrow a growler, take the starter motor to a starter repair shop and get it tested. Cost: about \$3.

How do you know when you have a problem in the starting system? Either the starter won't function or it will grind away very slowly (r-r-r-r-r) without the engine starting.

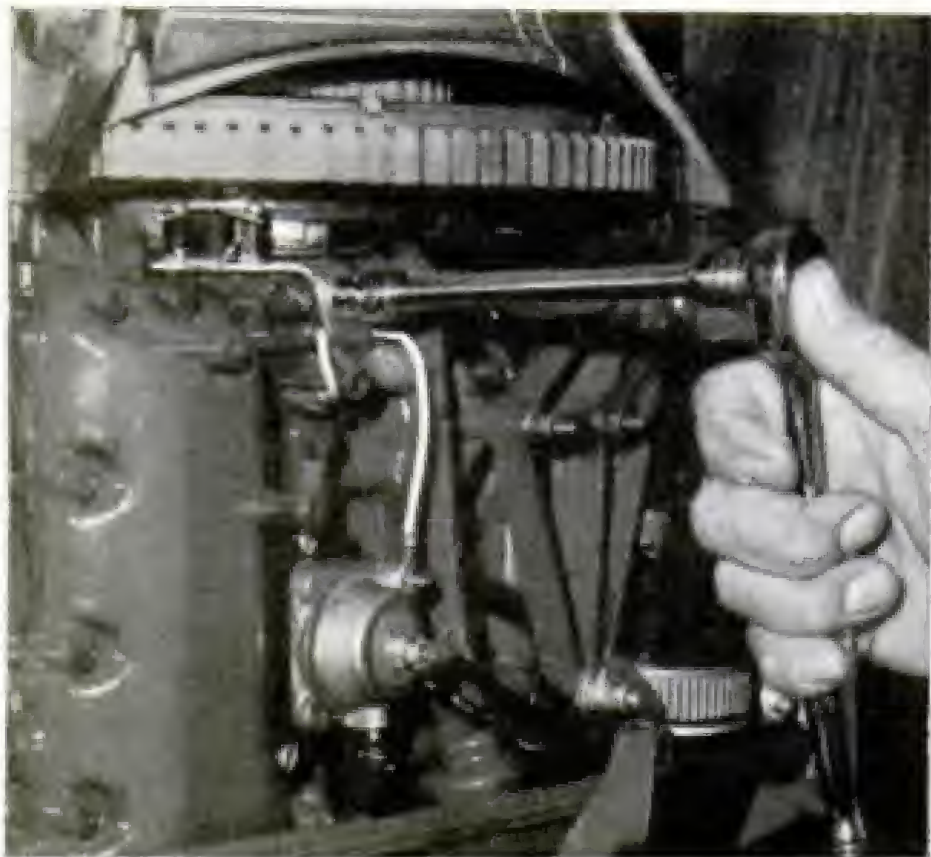
Should you experience a malfunction, such as starter grind or no-start, the cause could be loose or dirty electrical connections. The next most likely cause is a weak battery, followed by a defective starter solenoid or a bad safety switch. Seldom will you experience a breakdown within the starter motor itself although it can happen.

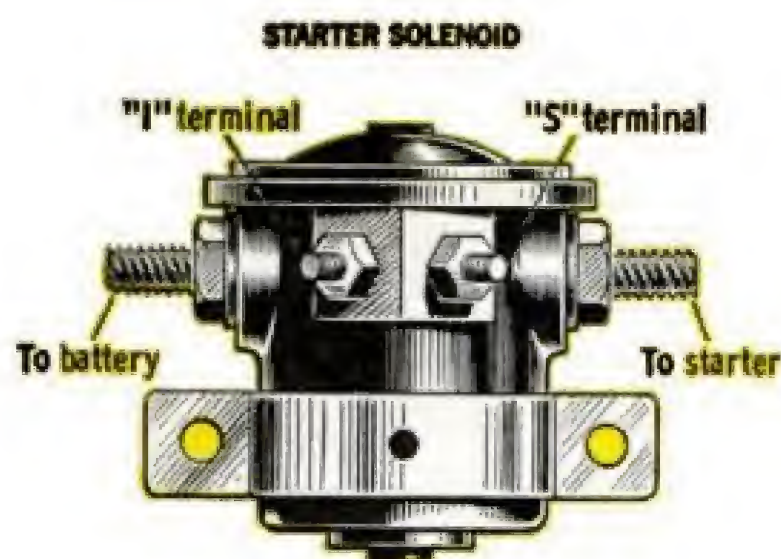
At the first sign of a starter-system failure, remove all electrical connections at the battery, starter solenoid and starter motor. Scrape them clean with a wire brush. Then reattach them firmly, making sure that attaching bolts are securely fastened.

Coat connections with liquid neoprene

8. THE SAFETY SWITCH is usually held in place by one bolt. This is easy to remove and to replace

9. THE PLUNGER of the safety switch is so positioned that it actually rides on cam seen at lower left





10. STARTER SOLENOID (above) is the key to the electric-start system. Jumper wires (right) connected to the solenoid terminals help you to determine whether or not the solenoid is in good condition

to seal them and prevent further corrosion. Liquid neoprene can be purchased from a dealer of marine supplies.

Next, check the battery by taking a specific gravity reading of the electrolyte with a battery hydrometer. In selecting a hydrometer, buy one that has a built-in thermometer and correction chart.

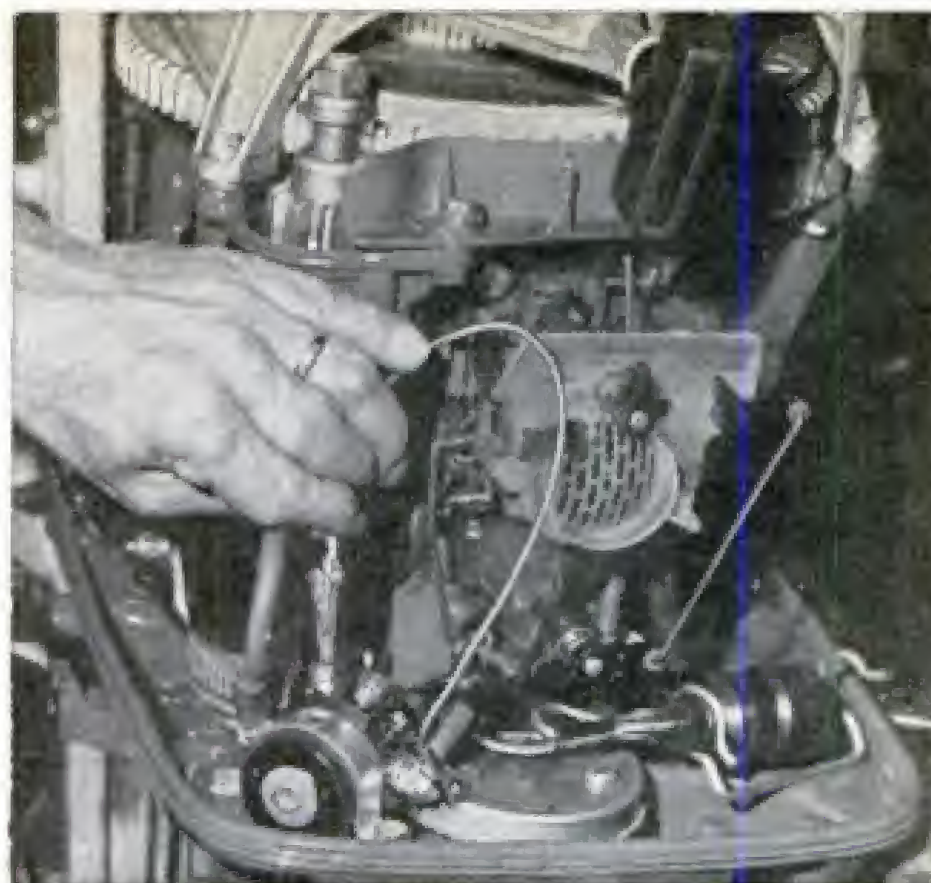
To take a specific gravity reading, draw electrolyte from each cell in turn. Be sure that the hydrometer float is free, hold the hydrometer at eye level, and note the reading. Be sure to return the electrolyte back to the cell from which it was taken.

The specific gravity of a fully charged battery is 1.260, but a battery with a specific gravity of 1.150 could start your motor. However, if specific gravity is this low, have the battery charged. If charging does not result in an increase in specific gravity in each cell, the battery has just about had it.

Now go to the safety switch and starter solenoid. The purpose of the safety switch is to prevent the engine from starting in gear and in neutral at too high an rpm. The switch also completes the ground circuit of the starter solenoid.

The starter solenoid makes and breaks the electrical circuit between the battery and the starter motor. If the safety switch or starter solenoid fails, there will be no starting.

To check the functioning of the safety switch, disconnect the starter terminal wire. There's only one wire. Hold the wire terminal to ground, bypassing the safety switch, and activate the ignition (Photo 7). If you get starter-motor action, it means the safety switch is either out of adjustment or is bad.



To readjust the switch, loosen it and work it back and forth (Photo 8). Place the switch's plunger on the cam of the armature plate (Photo 9). Try starting. If there is still no start, replace the safety switch.

To check the starter solenoid, place a jumper wire from either the "s" or "i" terminal to ground, and connect another jumper from the solenoid's battery terminal to either the "s" or "i" terminal—that is, the terminal not possessing the grounded jumper (Photo 10). Turn on the ignition. If the solenoid switch is in good condition, you'll hear it clicking away and the starter motor will crank as you activate ignition. If not, replace the starter solenoid.

Before replacing the safety switch or starter solenoid, there is one test you'd better make. There's always the possibility—*(Please turn to page 194)*

11. TURNING THE ARMATURE of the starter motor in growler is the best way to check for malfunctions



NEW IN



YOU CAN VIEW SLIDES and project them at the same time with the new two-way Sawyer's model above. For editing or previewing slides, the images appear on a built-in translucent screen. Flipping a switch converts the machine to a projector for showing slides on a large screen. The stack loader holds 36 slides. \$29.95. GAF Corp., 140 W. 51st St., New York.



INSTAMATIC OWNERS who have long been wanting a fast black-and-white film now have it. Kodak's Tri-X film, rated at ASA 400, now comes in 12-exposure cassettes. It should be used only in more advanced models, however, so check with a dealer before trying it in yours.



THIS BABY TANK lets you develop 35-mm film in broad daylight right in the cartridge. You slip the cartridge onto a spindle, insert it in the developer, then twirl the spindle back and forth to agitate the film. Pixmat tank comes with developer for \$1.98 in 20-exposure size, \$2.25 for 36 exposures. Burleigh Brooks, 44 Burlews Ct., Hackensack, N. J.



YOU CAN WASH ROLL FILM in four minutes with this handy tank. Jets of water feed into it from a hose connected to a faucet. As the water rushes in, a siphon effect draws in air through tiny holes, creating a turbulent bubbling action. This agitates the film and speeds the removal of fixer. Dirty wash water drains off at the top. Different models for 35-mm, 120 and 220 reels are \$22.95 to \$37.95. Pfefer Products, 6232 Atoll Ave., Van Nuys, Calif.



ACCESSORY LENSES for Instamatic cameras give you a telephoto or wide-angle effect even though the cameras don't take interchangeable lenses. The supplementary elements slip over the existing lens. Telephoto and wide angle are each \$10.95; sizes fit all Instamatic models. An auxiliary viewfinder is \$7.50. Kalimar, 2644 Michigan Ave., St. Louis, Mo.

PHOTOGRAPHY



Looking for a

Low-Cost Enlarger? Here's One for Under \$37

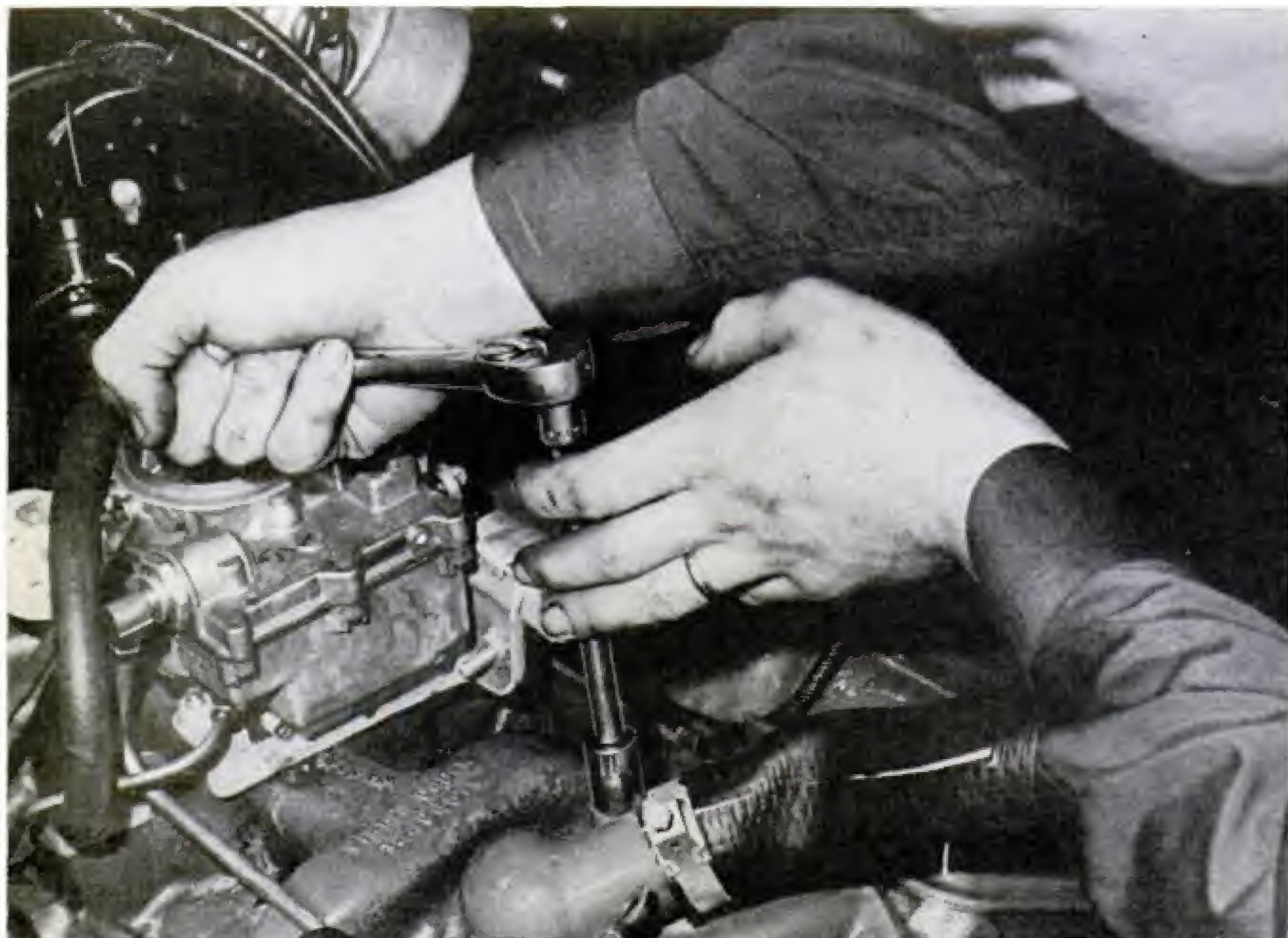
If you'd like to make occasional blowups of your snapshots without a heavy investment in complicated equipment, here's an ideal answer. It's a low-cost enlarger designed especially for small-format negatives. It will take either 35-mm film or the 126 size produced by inexpensive Instamatic cameras. Enlargements up to 8x10 inches can be made in the conventional way on the baseboard. For bigger blowups, you can project images onto the floor by reversing the column so the enlarging head hangs over the edge of a table.

The enlarger comes knocked down, as shown in the lower photo at left, and can be assembled in a few minutes. To save space,

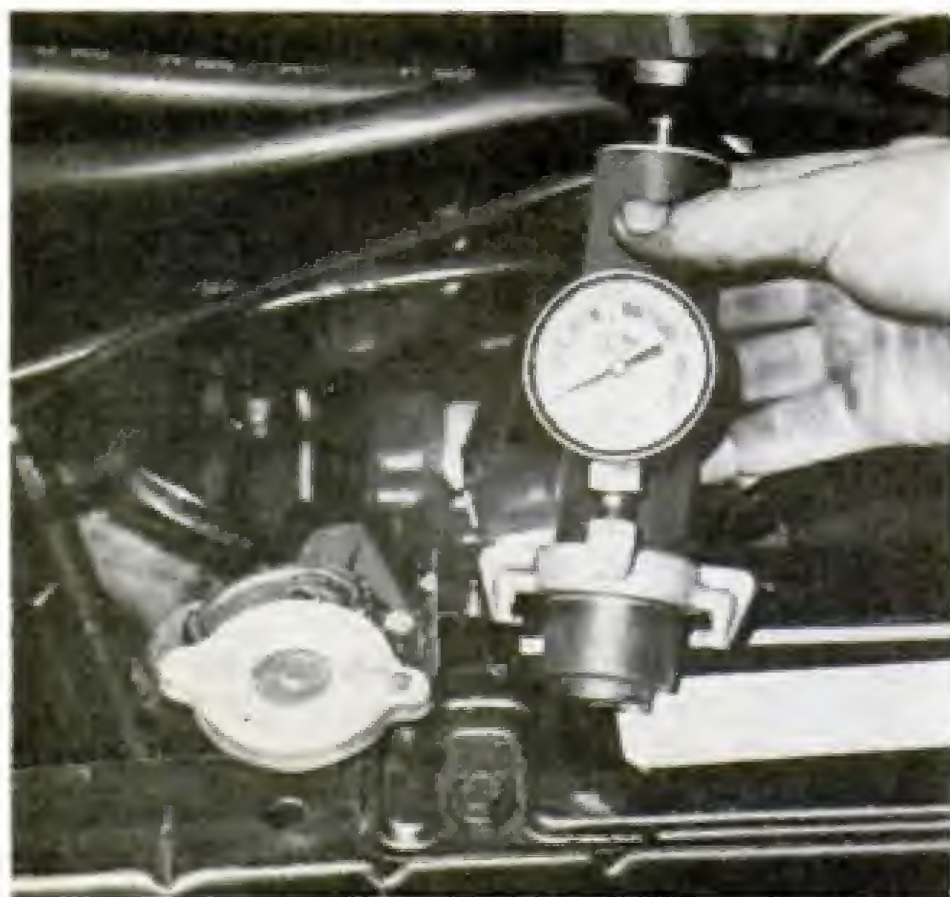
you can quickly disassemble the rig and store it in a closet or bureau drawer whenever it's not in use. The optics consist of a three-lens condenser system that produces surprisingly bright, sharp images. The enlarging head slides up and down on the column to vary the magnification from 1.8 times to 10 times. For focusing, there's a smooth rack-and-pinion adjustment with dual knobs, so you can use either hand—just as on big enlargers.

Interchangeable negative carriers—one for 35 mm and one for 126—slip easily into the head, as in the upper photo at left. Price for the Durst J35 enlarger is \$36.95. Durst, Inc., 623 Stewart Ave., Garden City, N.Y.

Hot Tips on



THERMOSTAT HOUSING, where top radiator hose connects to engine block, is removed for access to thermostat. Check for proper temperature operation. Radiator pressure tester checks cap for pressure rating. Tester also attaches to radiator neck to pressurize entire system in test for leaks



WHEN YOU STAND BACK and watch your radiator erupt like a geyser you feel pretty helpless. Don't let it happen ever—or again as the case may be. A little conditioning for your cooling system once a year will make the possibility quite remote.

Start with your radiator pressure cap. The cap allows pressure to build up in the cooling system. When a liquid is put under pressure, its boiling point increases. Radiator pressure caps raise the boiling point of coolant by about 3°F. for each pound of pressure for which the cap is rated. Thus, a 15-lb. pressure cap increases the boiling point of the coolant by about 45°. This is enough to keep the engine from overheating during periods of extreme heat load, such as when driving long hours at superhighway speed.

To test the cap, you'll need a radiator and pressure-cap tester. It costs about

Engine Cooling

\$15, but maybe your service station will check it as a courtesy. No harm in asking.

First, wash the cap in clean water and attach it to the tester. Pump up pressure to its stamped rating. If pressure drops, the cap is faulty and should be replaced.

Make sure the cap you buy carries the same model number as the old one. There are different types. What works in your neighbor's car probably won't in yours.

When you test the cap, check the radiator filler neck for foreign matter and nicks that could keep the cap from seating properly. A strip of emery cloth or wire brush will get rid of minor nicks.

Most radiator leakage problems are due to failure of soldered joints. They can be repaired.

Attach the pressure tester to the filler neck and pump it up to the pressure stamped on the cap. If pressure drops rapidly, inspect external parts for leaks. Replace a leaking hose or water pump.

If a radiator is leaking, you can try a stop-leak and sealer chemical. Be sure to follow instructions on the package, but keep in mind that this is a temporary fix for small leaks. Leaks along seams, around the filler and outlet necks, or around drain cocks will have to be plugged permanently by resoldering.

Now, if there is no external leak, but pressure continues to drop during the test, inspect the engine oil by means of the dipstick to determine if coolant is leaking into the crankcase. If the oil looks white, you have a cracked cylinder block or, if lucky, a leaking head gasket.

You can use the tester to check for combustion leakage into the cooling system, too. Warm the engine to operating temperature and install the tester. With engine running, pump the system up to the cap's rating. A fluctuating tester-dial needle indicates a combustion leak.

If torquing of the cylinder head to specification doesn't stop this fluctuation, replace the cylinder-head gasket. Don't allow a combustion leak to continue. Gases leaking into the cooling system combine



COOLING SYSTEM LEAKS, otherwise difficult to detect, are quickly revealed when entire system is put under pressure with radiator pressure tester. Check water pump as possible source of cooling system leak. As shown below, area around diaphragm should be inspected with system under pressure



with coolant to form acid that eats away at cooling system and engine parts.

Check for coolant circulation by warming the engine to operating temperature and then shutting it off. Feel the radiator. It should be hot at the top and warm at the bottom, with an even temperature rise from bottom to top. Cold spots indicate a clogged section. A good cleaning, described below, should clear it.

To check functioning of the water pump, run the engine and squeeze the upper radiator hose. If you feel pressure surges, the water pump's okay. By the way, most water pumps have a vent that can get plugged and hamper operation. Clean it out before condemning the pump.

Once a year you should flush and clean the system even though you use a so-called "permanent" antifreeze. It contains rust inhibitors that lose their effectiveness in a year's time. You can use a good cleaning solution to flush out the system. Follow package instructions carefully, and always flush out thoroughly with water.

Fill the system with clean water. Open the heater control fully, so the heating system is flushed, too, and run the engine long enough to open the thermostat—say, for a good 30 minutes. Drain by opening all drain points.

Now, fill the system with fresh coolant. You should use a good quality ethylene glycol antifreeze mixed with water to provide protection to minus 20 F. This solution does a couple of things as well in summer as winter.

First, a good-quality ethylene glycol contains inhibitors which help to prevent rust. Secondly, it guards the system against overheating—a summer problem. Water boils at 248°F. in most cooling systems. But a 44 percent ethylene glycol, 56 percent water solution (protection to minus 20°) boils at 264°F. This difference could be a critical factor. *Never* use straight, undiluted ethylene glycol. It doesn't dissipate heat as rapidly as a mixture of ethylene glycol and water, for one thing, and you'll be wasting money.

Your hoses, although they may not be leaking, could be rotting inside, sending particles into the system. Feel the hoses. Replace any that are soft and spongy.

When replacing a hose, clean the pipe connection with a wire brush and apply a nonhardening rubber-hose sealing compound, such as Permatex, which you can



HOSE CONNECTIONS are important for a tight cooling system. To insure a good seal, clean inlets and outlets; use a nonhardening sealing compound



HOSE CLAMPS, if they are the screw-down type, should be tight for a good connection. Using a ratchet wrench is easier than using a screwdriver



THERMOSTAT is lifted from its seat for inspection and testing (see text). Gasket came off in one piece but should be replaced nevertheless

buy at an auto supply store. Secure clamps tightly; a pressurized cooling system can blow a hose right off its seat.

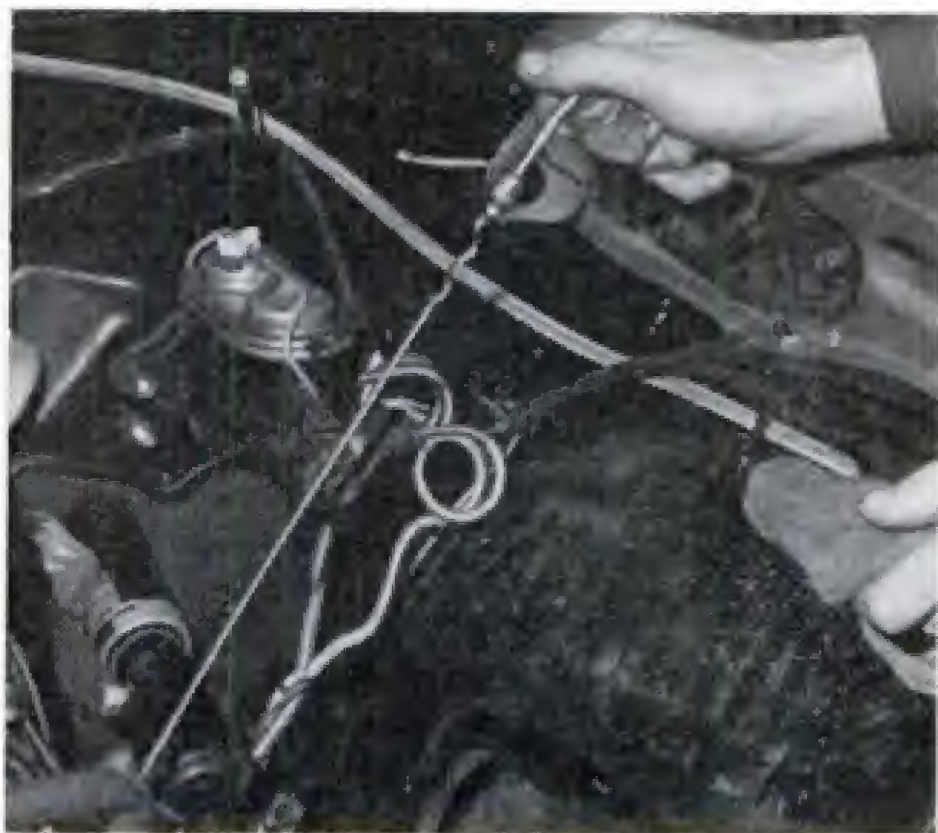
Here's another tip. The lower hose from engine to radiator contains a spring coil that keeps it from collapsing under high pressure. If your car suddenly starts to overheat at high speed for no reason, replace the hose. The spring may have lost tension.

Check your thermostat next. This is especially important if your car has an idiot light instead of a water temperature gauge. You can't tell if the engine is operating at correct temperature, since most of these lights go off at 125°.

Before adding fresh coolant to the system after cleaning, take the thermostat from its housing and place it in water



RADIATOR OVERFLOW TUBE extends from the filler neck down the side or back of the radiator to relieve the system of excess coolant when necessary



ENGINE CRANKCASE should be checked in case of a mysterious loss of coolant. Oil will be whitish if coolant's leaking through crack or past gasket

which is heated to a temperature that is 25° above that stamped on the thermostat housing. Agitate the water thoroughly to get even temperature distribution throughout, and watch the stat valve. It should open fully.

Remove the stat and place it in another bucket of water which is 10° below the specification. Again agitate and watch the valve. It should close. If not, replace the stat with a new one. Even if you reinstall the same part, use a new housing gasket.

The radiator overflow tube, usually rubber, hangs from the filler neck down the side or back of the radiator. It lets excess coolant leave the system. Be sure the tube is there and in good shape.

By the way, never remove the radiator cap when the engine is at or near operating temperature. *Check coolant when the engine is cool.* When the radiator cap is removed, the cooling system is no longer under pressure and the coolant will start to boil. You'll lose coolant out the top or out the overflow tube.

You'll also lose coolant out the overflow tube if you overfill the radiator. When it's filled above the recommended level, usually one inch below the filler neck with the engine cold, no room is left for expansion. Overflowing coolant may lead you to think your car's overheating.

Removing foreign matter from radiator fins is important for proper cooling. Bugs and leaves can obstruct the flow of air through the radiator core. Blow out the core with compressed air from the rear.

A slipping fan belt prevents the water pump from circulating sufficient coolant. Make sure belts are in good shape and tightened to specification. And, don't forget to set ignition timing. Timing, especially overadvanced timing, can cause an engine to run hot.

Finally, don't forget the possibility of *overcooling* when winter comes. This condition can cause partial fuel combustion and crankcase oil dilution. If allowed to continue, cylinders, rings, pistons and bearings can suffer.

Overcooling most often results from a thermostat stuck in open position. The coolant isn't kept in the engine long enough for it to warm up. Signs of this are an increase in fuel consumption and sparkplug fouling. If plug tips are black or sooty, combustion is not complete, possibly due to overcooling. ★★★



RECORD CHANGER and FM/FM-stereo receiver are stacked together in a space-saving piggyback design in this Knight-Kit compact by Allied. Wiring is simplified by printed-circuit boards and easily joined subassemblies (upper left)

Hi-Fi Compacts

BY JOHN A. LINKLETTER and SHELDON M. GALLAGER

THE GROWING POPULARITY of the stereo compact is bringing with it a new breed of kit—a build-it-yourself home entertainment center that combines virtually all of the basic hi-fi components you need in a single, stylishly designed package. Two of these kits, assembled by PM editors, are the Knight-Kit KG-980 above, sold by Allied, and the Heathkit AD-27 shown on the opposite page.

Both units consist of a solid-state FM/FM-stereo receiver and an automatic turntable that plays records singly or in stacks. The receiver also doubles as an auxiliary amplifier for powering other components, such as a tape recorder. The Knight-Kit model is rated at 25 watts per channel and the Heathkit at 15.

The two models offer a choice of different styles. The Knight-Kit is an over-under affair with the turntable squatting on top of the receiver. The Heathkit uses a side-by-side arrangement with the receiver's control panel facing upward next to the turntable. Both come with trim walnut cabinets. An added feature on the Heathkit is a tambour door that slides out to cover the top and front.

Both kits were assembled over a period of several weekends. Construction time ran to about 38 hours on the Heath-

kit and 45 hours on the Knight-Kit. For the first-time kit-builder, the immense piles of parts that emerge as you open the boxes may seem like a staggering undertaking to face, but the work goes smoothly and surprisingly fast considering the complexity of the circuits. One reason is that modern solid-state circuits, while more complicated, are actually easier to wire than older tube circuits. Instead of



COMPLETED KNIGHT-KIT CHASSIS slides neatly into walnut cabinet like a drawer. Motor on record changer hangs down in open space on top of chassis



SLICKLY STYLED HEATHKIT COMPACT has unusual top-mounted control panel that nestles right alongside the automatic turntable. A disappearing tambour door slides forward from the rear to cover the top and front, keeping out dust and giving a trim appearance



You Can Build From Kits

Those nifty space-saver radio-phono hybrids now come in knockdown versions you can assemble yourself. Here are two that offer kit-building fun as well as cost savings

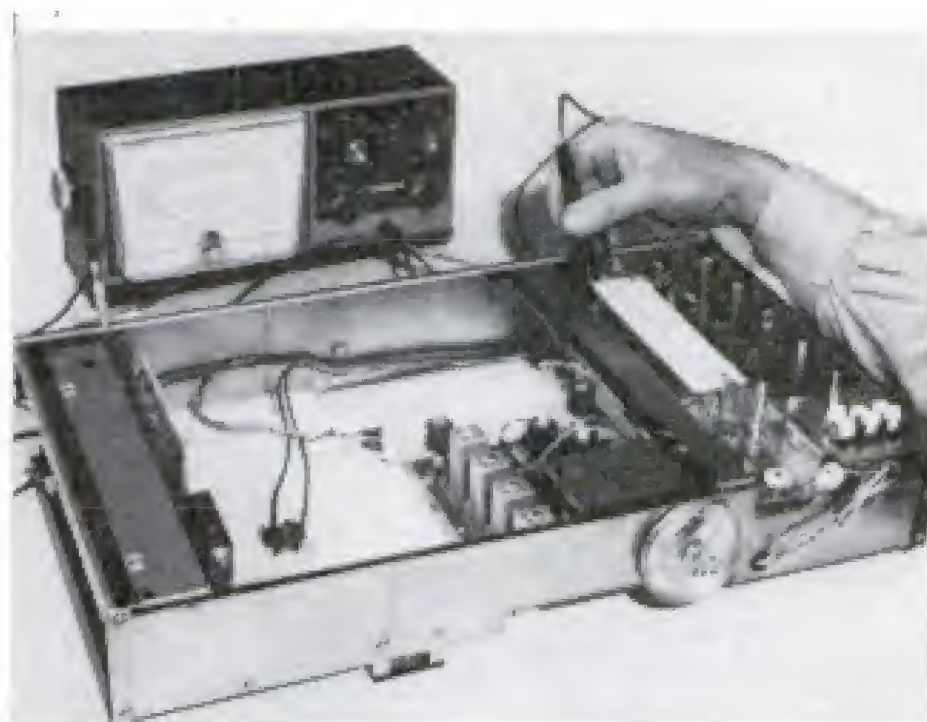
fumbling around in a cramped chassis, you do all your main wiring on three or four printed-circuit boards out in the open where you can reach the parts easily. It then takes only a few wires to join these subassemblies for the final hookup.

The Heath and Knight-Kit instruction manuals are remarkably detailed and easy

to follow. Allied follows its traditional practice of supplying resistors on numbered cards. All you do is look for the right number without having to identify each resistor by its color coding. The Heath manual includes a handy checkout guide for testing resistances before you turn on the power. This way, you aren't likely to burn anything out when you fire up the set for the first time.

The Knight-Kit KG-980 comes with two matching preassembled speaker enclosures for \$339.95. The speakers sell separately for \$75 apiece so you can figure that the compact itself represents about a \$190 value. The Heathkit AD-27 sells without speakers for \$169.95. Speaker enclosures for use with the Heath unit are available in kits for about \$40 to \$60 each.

The phonograph mechanisms come pre-assembled, and both are four-speed types. The Knight-Kit incorporates a Garrard SL65 and the Heathkit a BSR McDonald 500—both fine turntables. The Knight-Kit KG-980 is available from Allied Radio, 100 N. Western Ave., Chicago, Ill. 60680. The Heathkit AD-27 is sold by the Heath Co., Benton Harbor, Mich. 49022. ★★



MAKING FINAL CHECKS on Heathkit chassis with an ohmmeter tells you wiring is okay before turning on power. Meter isn't essential, but is an added help

BUILD THIS FOLDAWAY HOBBY CENTER

Compact wall cabinet serves both father and son in providing the ultimate in a place to tinker or get lost in a hobby

By HANK CLARK

Technical Art by Fred Wolff

ANY HOBBY can be twice the fun when you have a place all your own to work. A place that's off limits to other members of the family, that has everything within easy reach and can be closed up for safe keeping when you walk away.

Whatever your hobby—model building, slot cars, electronics, trains or just plain tinkering—this hobby center is the ultimate in a place to work. You can come and go without having to clean up each time; there are shelves, drawers and tool panels galore, and it all folds up into a compact wall cabinet that's only 18 in. deep.

The center is unique in the way it unfolds for work. It has a 24x48-in. "workbench" that lets down like a drawing board, nesting tool-panels that swing out and a bank of drawers that swing with a door to reveal inner shelves for paints, airplane dope and parts. A sound-absorbing pinup board of acoustical tile across

the back lets you stick up what you can't hang up. There's a nook for books and room to display your "works of art." What's more, there's a tray under the hinged drawing-board workbench for storing drawing paper, plans and other drafting essentials, and when the workbench swings up, you have a second pinup board on the underside. A strip line outlet across the back of the work center provides convenient plug-ins for a hand grinder, soldering iron and glue gun.

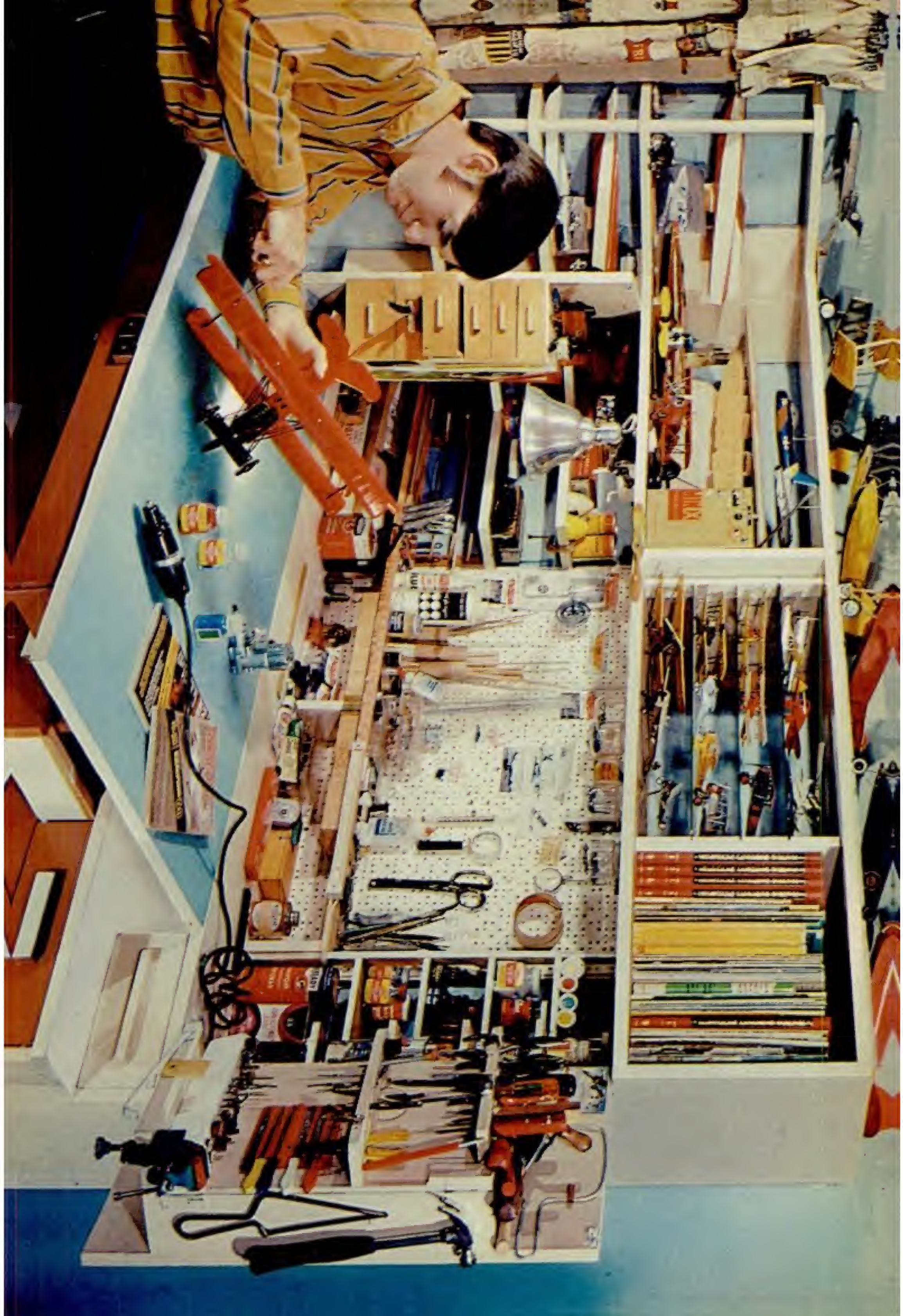
A handy lamp on an adjustable swiveling arm is attached to the upper shelf so it can be aimed right down on your work. The lids of baby-food jars screwed to the underside of the upper shelf let you store countless small parts in glass jars, and the four large drawers under the counter give you more storage space than you'll know what to do with.

The slanting workbench is supported by

SHALLOW TRAY hinged to underside of drawing-board workbench provides storage for plans, papers

HOW CENTER LOOKS WHEN CLOSED. Celotex bottom in tray provides pinup board for clippings and photos



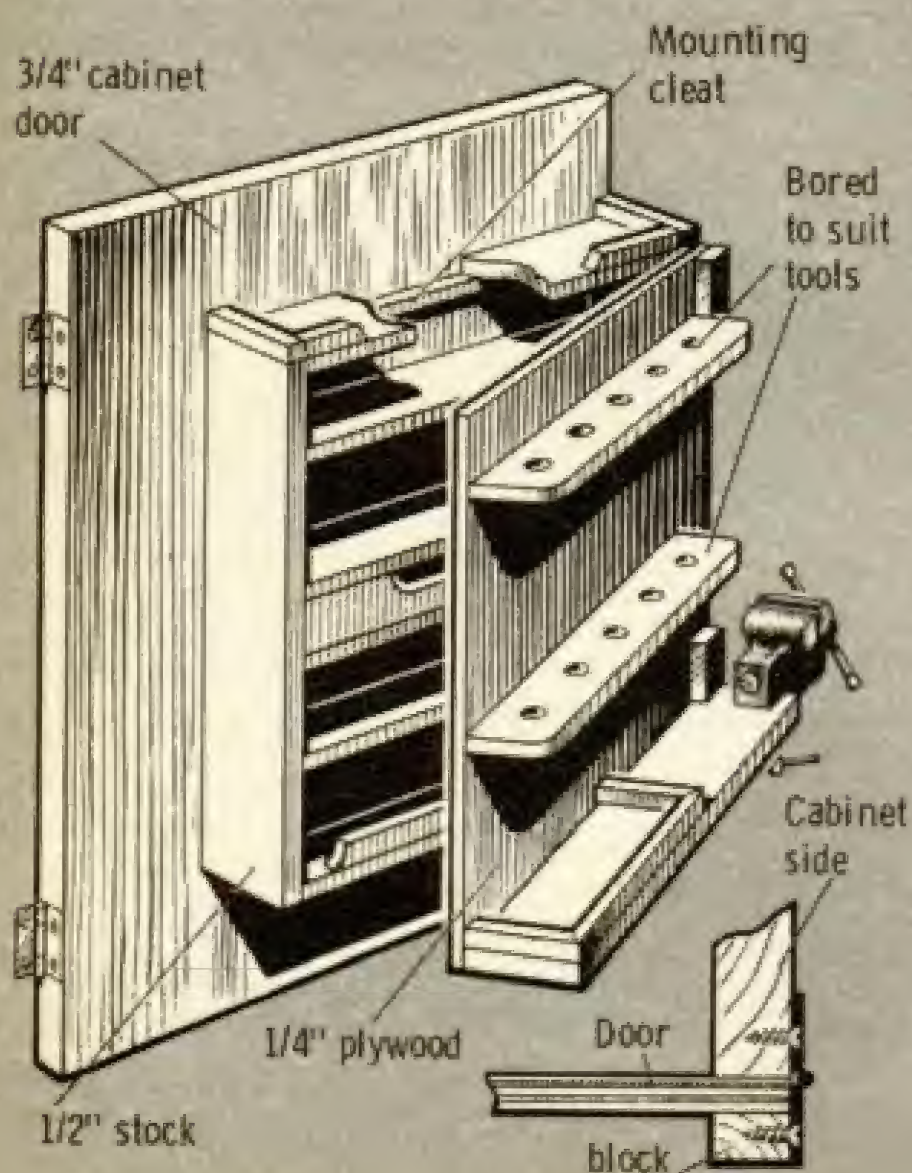
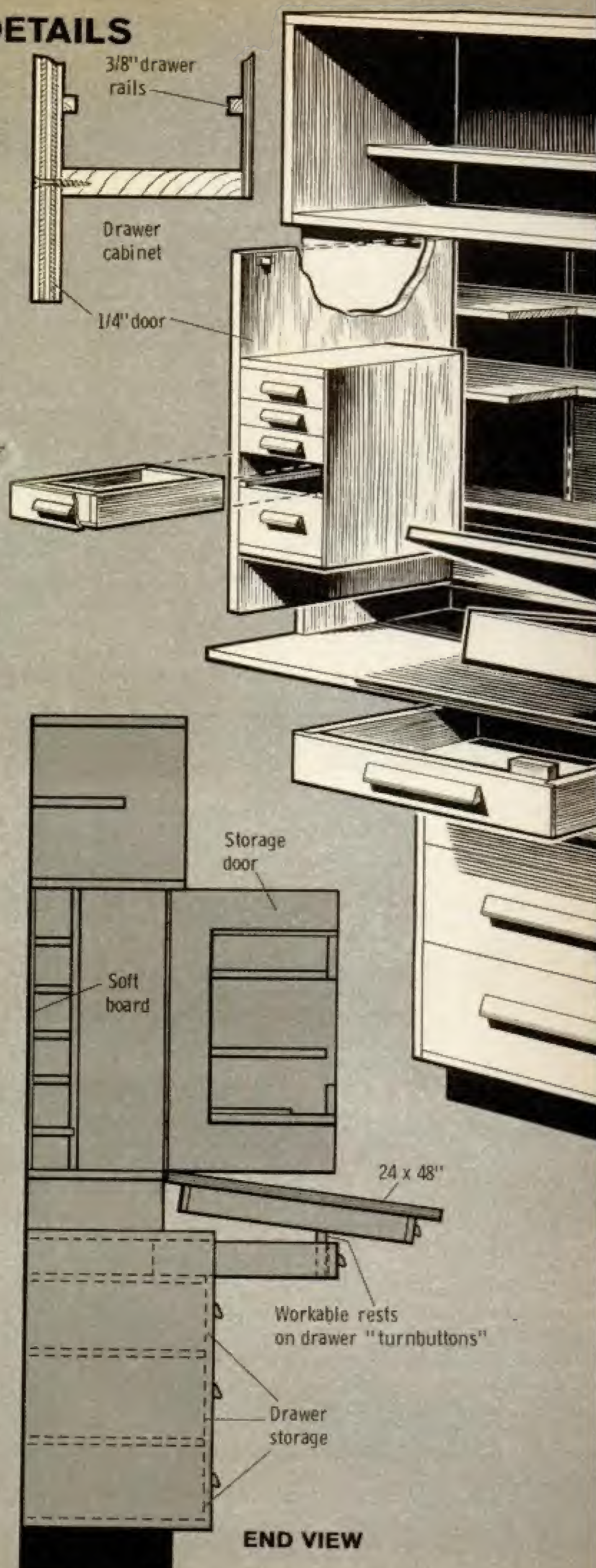


BASIC CONSTRUCTION DETAILS

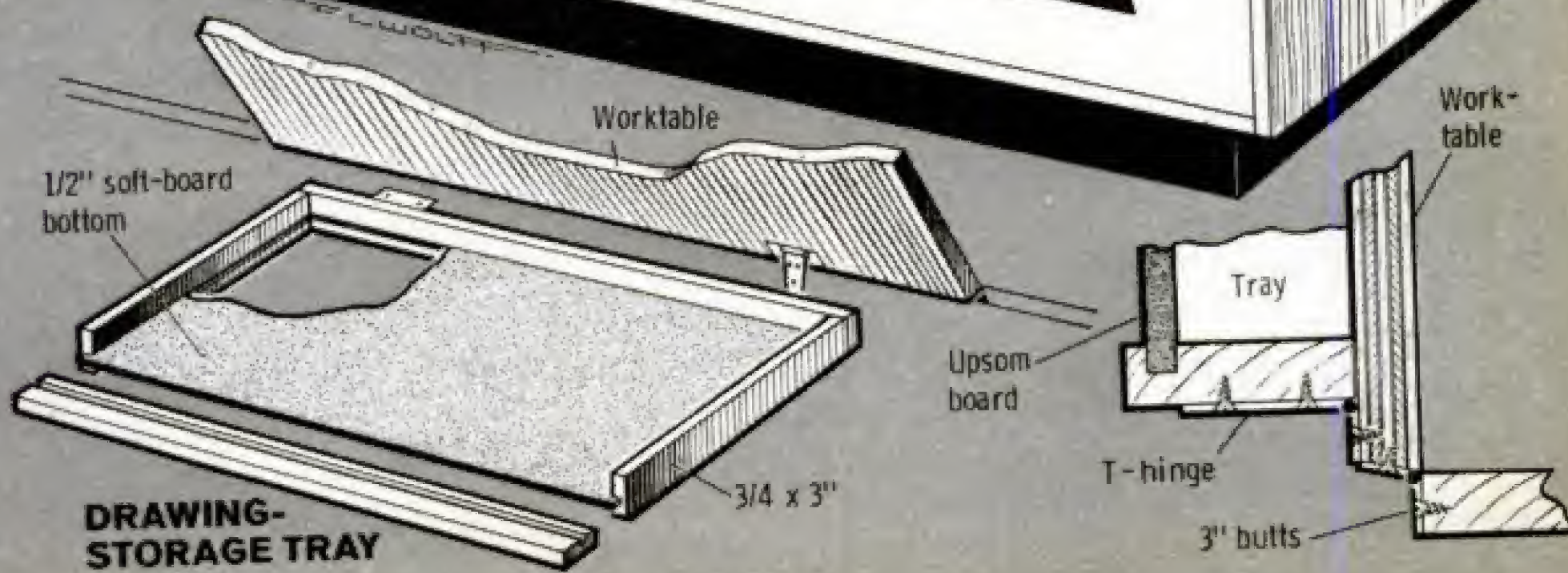
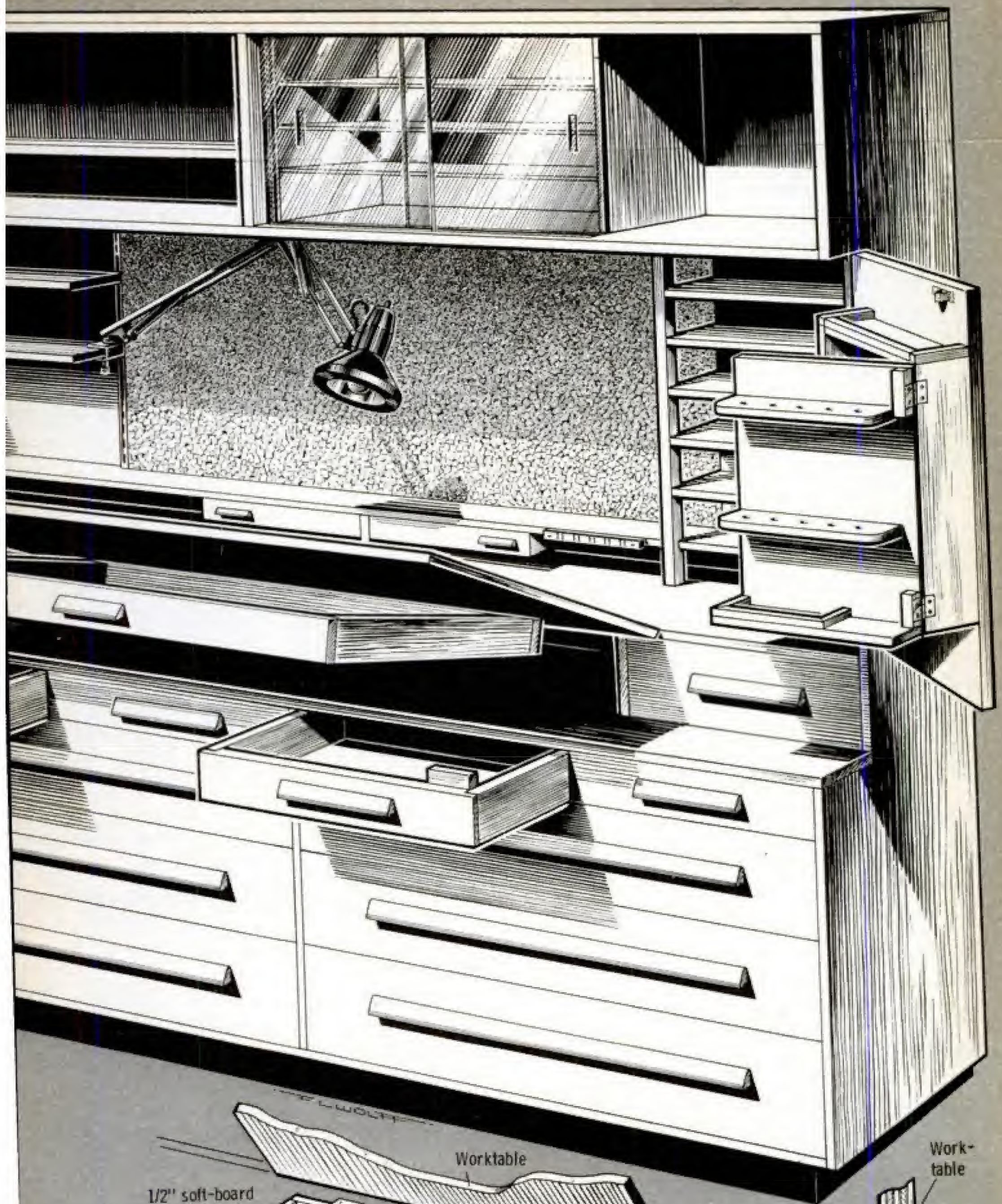
two drawers which have turnbutton legs attached to the inside. The legs swing down inside the drawers to let you close them. To clear the workbench for swinging it up, materials and work can be pushed back under the 12-in. bottom shelf. A cupboard catch screwed to the upper shelf holds the workbench in a vertical position.

Your hobby center should be a minimum of 6 ft. long to accommodate a 48-in. long workbench. The end pieces of the cabinet are 18-in.-wide plywood and cut back to 11½ in. at a point 29 in. from the lower end. The ends are joined with a 1x12 shelf placed 11 in. down from the top and with an 18-in. wide counter. Then a second 1x12 shelf is placed between the ends, 5 in. above the counter. Next, a 1x6 is placed vertically between the two 1x12 shelves 16 in. in from the right-hand end and flush with the back of the cabinet. Four short shelves are fitted between the 1x6 and the cabinet end. A second 1x6 is installed vertically at the opposite end of the center tool panel and another shelf is placed between the 1x6s, 5 in. up from the lower 1x12. The area above this shelf is filled with a Celotex or cork pinup board.

The slanting workbench is hinged to the edge of the 1x12. When it swings up it laps the two swing-out doors. ★★★



END VIEW



ALL-TIME GREATS



No. 1: A Game Table For Your Playroom

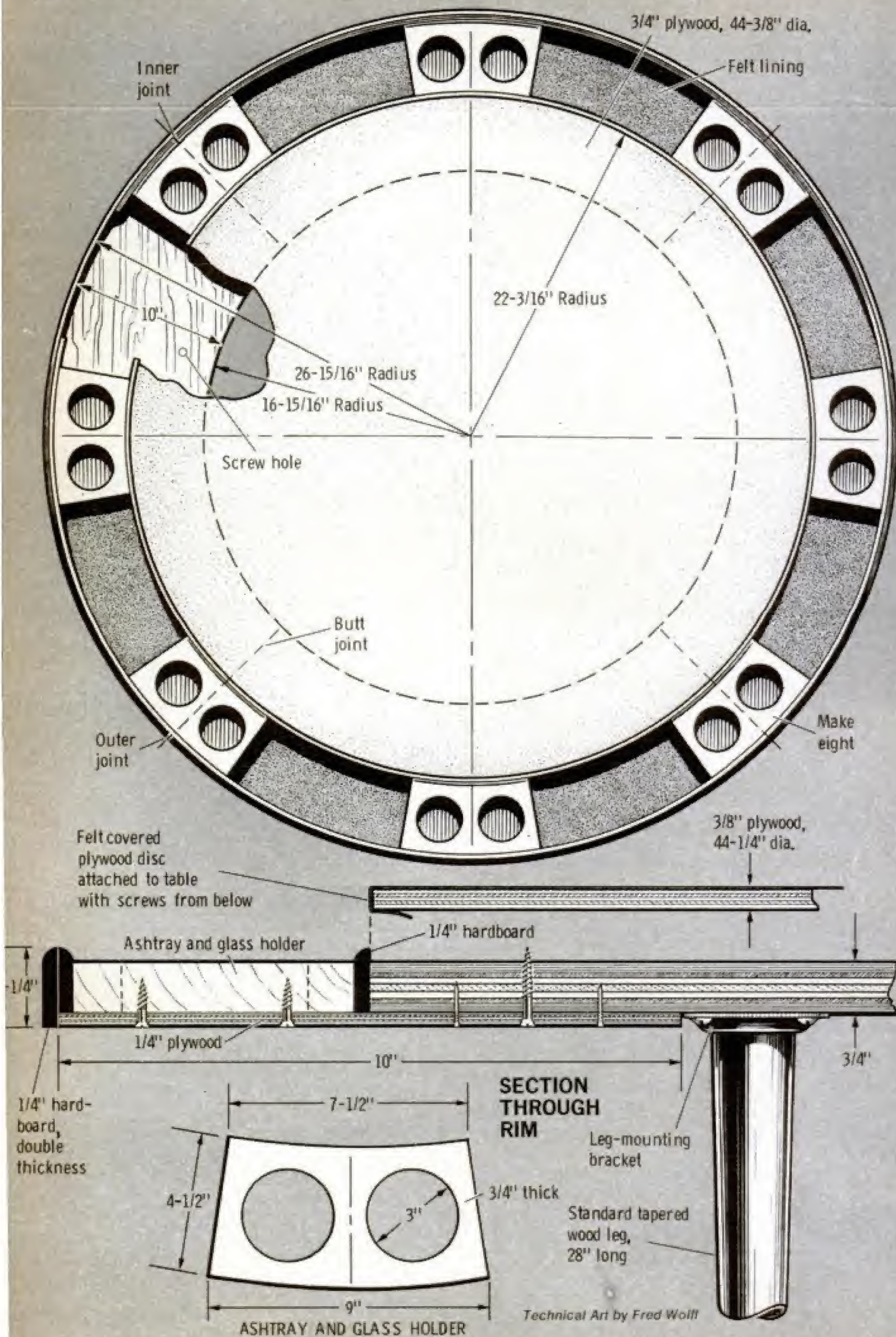
Great projects never die, but sometimes we forget how popular they were. Here's one that made a hit in PM 11 years ago, updated and restyled for 1969

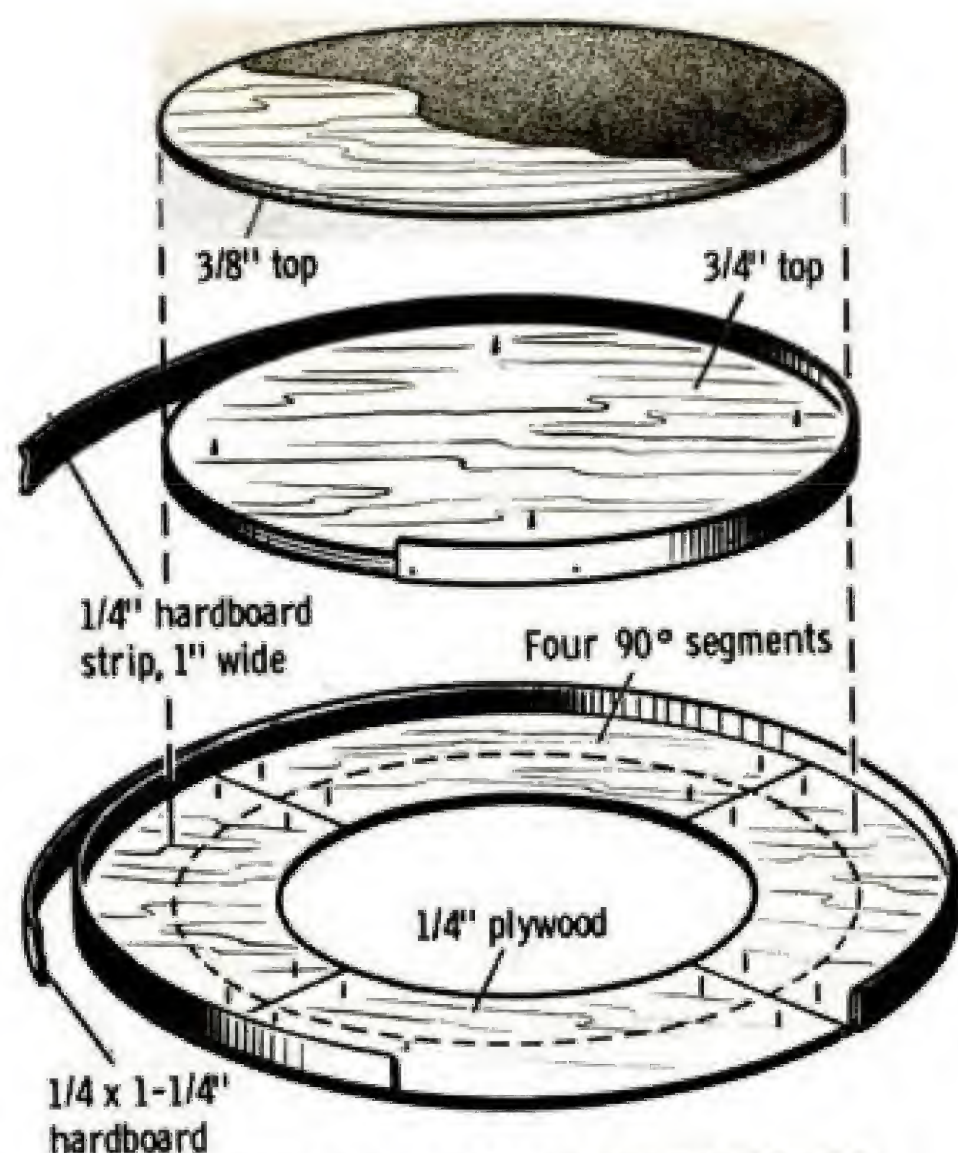
WHAT MAKES ONE PROJECT more popular than another? Built by more, enjoyed by more? It's hard to say, but over the years there have been extra-special ones that have made such a hit that countless readers have written us and proudly sent snapshots of how they turned out. One such project is this family game table, first published in October 1958. It's truly one of PM's "all time greats." We'll bring you others in the months to come. Readers who remember the original table by John Bergen will notice that we have updated its construction and simplified the job of making it. Basically, it consists of three circular assemblies—a bottom chip-and-glass tray, a center disc and a felt-covered top—all cut from plywood to nest one on top of the other. Start with the center disc. If you have a router, you can cut a perfect circle by tethering it to a strip of wood with a nail in the end. If you don't have a router, use your sabre saw. Four quarter-circle segments are cut from 1/4-in. plywood and



Color Photos by William Aller

PLAN VIEW OF TABLETOP





HOW THE PARTS SANDWICH TOGETHER



OPTIONAL SUPPORT

Card table can be used to support top if you wish

FELT CAN BE STRETCHED without puckering if you first staple one edge and then the edge directly opposite



YOU CAN BUY ready-made legs that screw into mountplates, or simply use a card table to support top

nailed to the underside of the center disc to form a tray. Then the edge of the disc is "wrapped" with a 1-in.-wide strip of 1/4-in. hardboard and nailed and glued. Next eight glass-holder dividers are added equidistantly around the plywood tray, four of them being placed over the butted joints. Finally, the outer edge is wrapped with a double strip of hardboard. Glue and nail one at a time and place the joints of the two strips 180° apart. The top playing surface is a 3/8-in. plywood disc, which is covered with green felt stapled to the underside, and attached with screws. The legs screw into metal mounting plates. ★ ★ ★

A CAN OF SPRAY PAINT is the simplest way of finishing ready-made wooden legs any color you wish

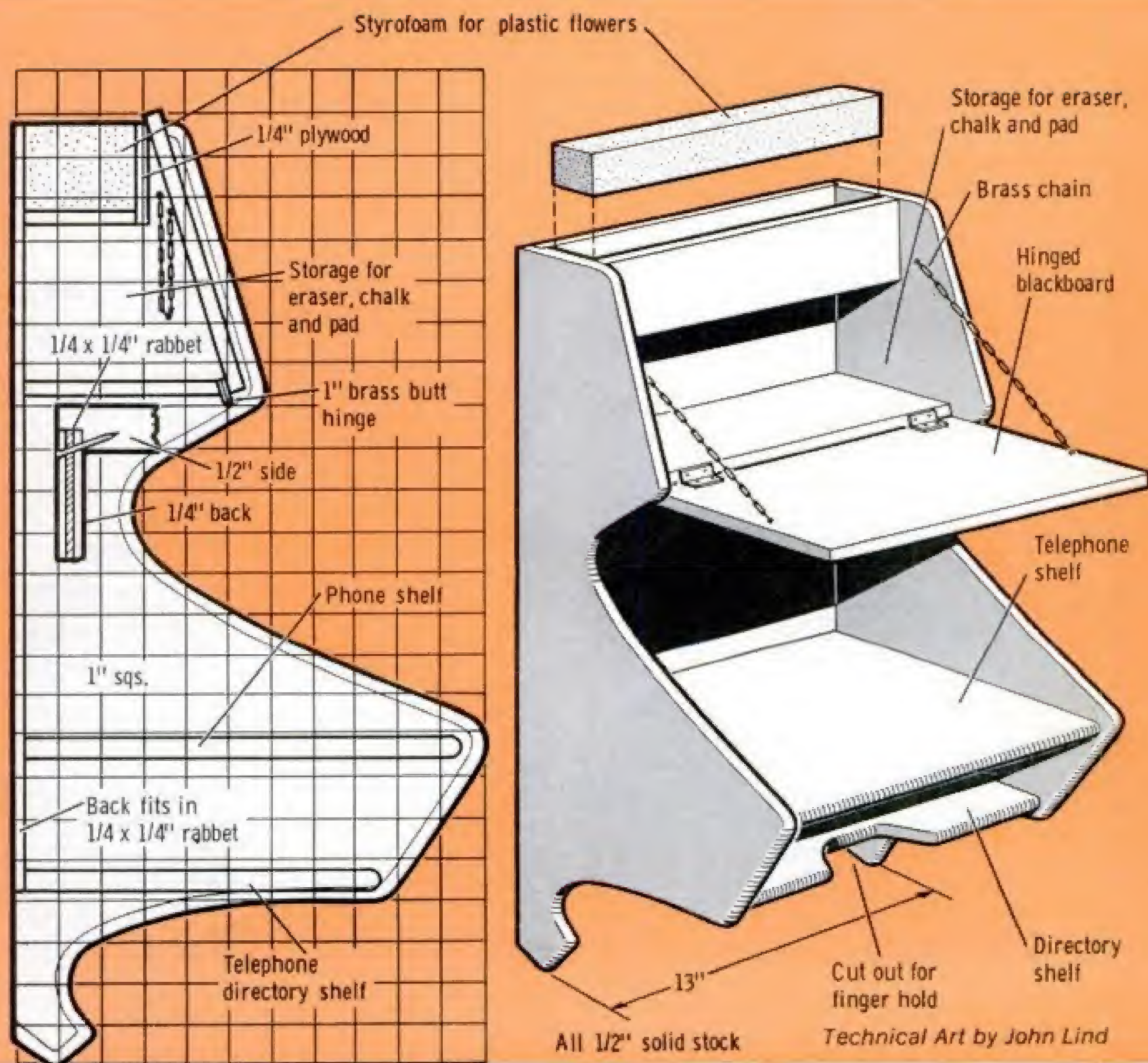




Build This Phone Center

A WALL PHONE IS HANDY, to be sure, but not handy enough when it comes to making or taking a call. There's never a directory at hand for you to look up a number, and no place to jot down a message. That's all changed with this hanging phone center. There's a built-in compartment big enough to hold the fattest phone book, and a blackboard where you scribble a message no one will fail to see. There's storage behind the blackboard for an eraser, chalk, pencils and pad. As you can see, it's a handsome piece when made of walnut and "planted" with plastic greenery.

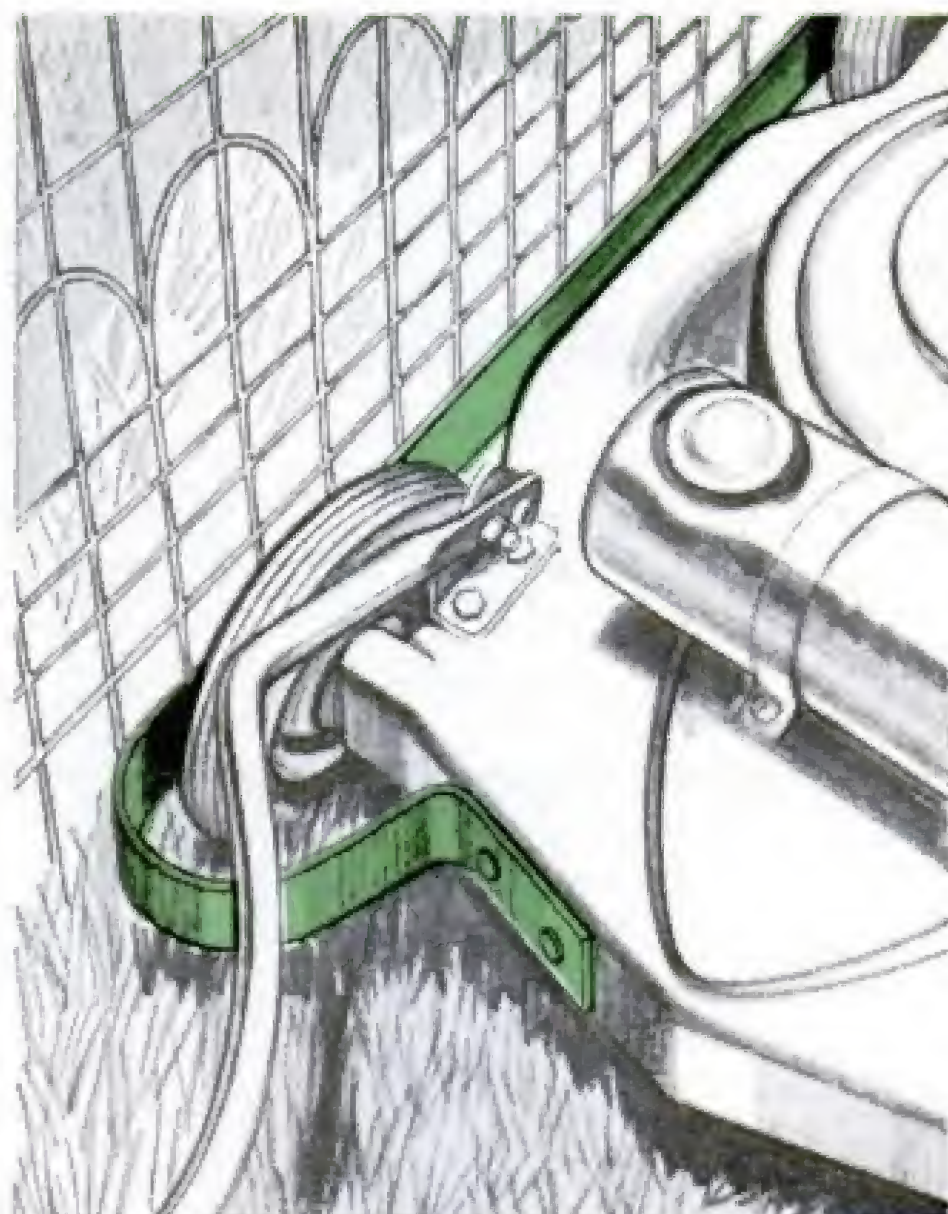
If you are working with walnut, the best construction is to fit and glue the three shelves in $\frac{1}{4}$ -in.-deep dadoes cut in the sides; if plywood and to be painted, you can simply butt the shelves and nail them through the sides. Both side members are twins, but made right and left-hand. The blind shelf dadoes are made before the sides are cut out, then rabbets are run for the $\frac{1}{4}$ -in. back. The planter box for the Styrofoam "soil" is assembled from $\frac{1}{4}$ -in. plywood and merely glued in place. The hinged drop-front is given two coats of special blackboard paint, and tiny brass hinges and chain are attached to hinge and support it. Shaped edges always give a project a professional look. If you have a corner-rounding router bit, you might use it to relieve the square edges of the sides and two bottom shelves. ★★★



Solving home problems



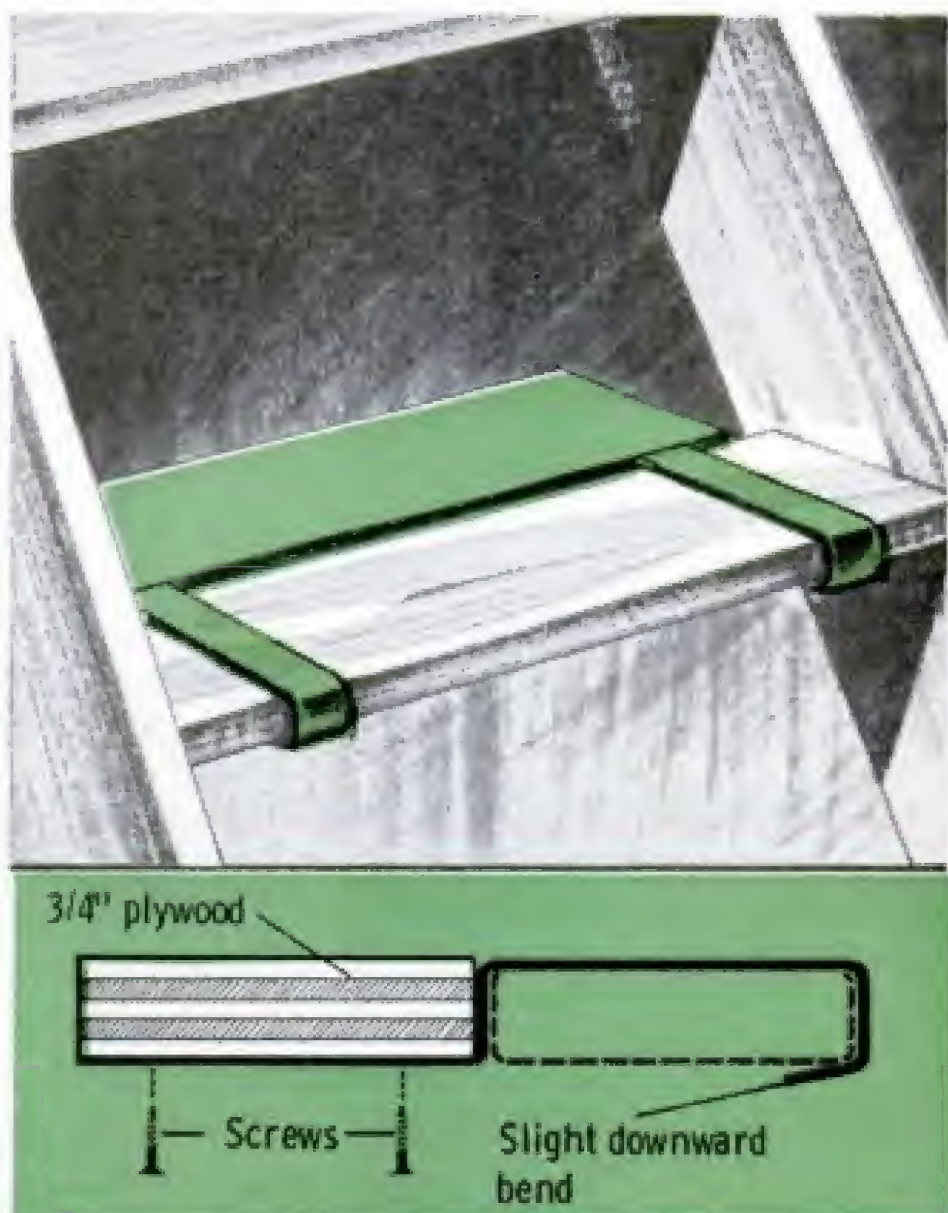
NOVEL QUONSET ROOF for home-built doghouse is provided by half an oil drum. Cut lengthwise through drum at point 1 in. past the centerline, using a metal-cutting blade in a sabre saw.—Victor H. Lamoy



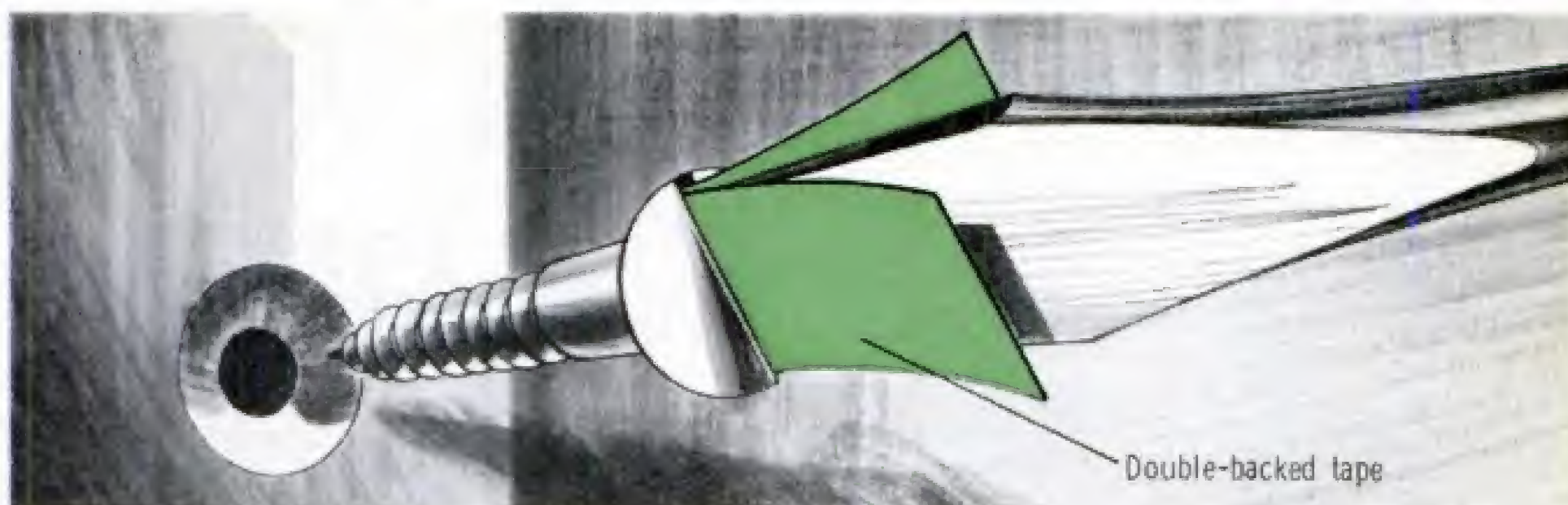
WRAPAROUND "FENDER" for rotary mower permits mowing close to fence without catching wheel in the wire. It consists of $\frac{1}{8}$ x 2-in. flat iron bent around wheel, attached with stovebolts.—Carl H. Hubachek



WHEN STAINING LARGE SURFACES, such as wall paneling, your wiping cloth soon becomes saturated. You can avoid winding up with a stained hand by using a plastic sandwich bag for a glove.—Victor H. Lamoy



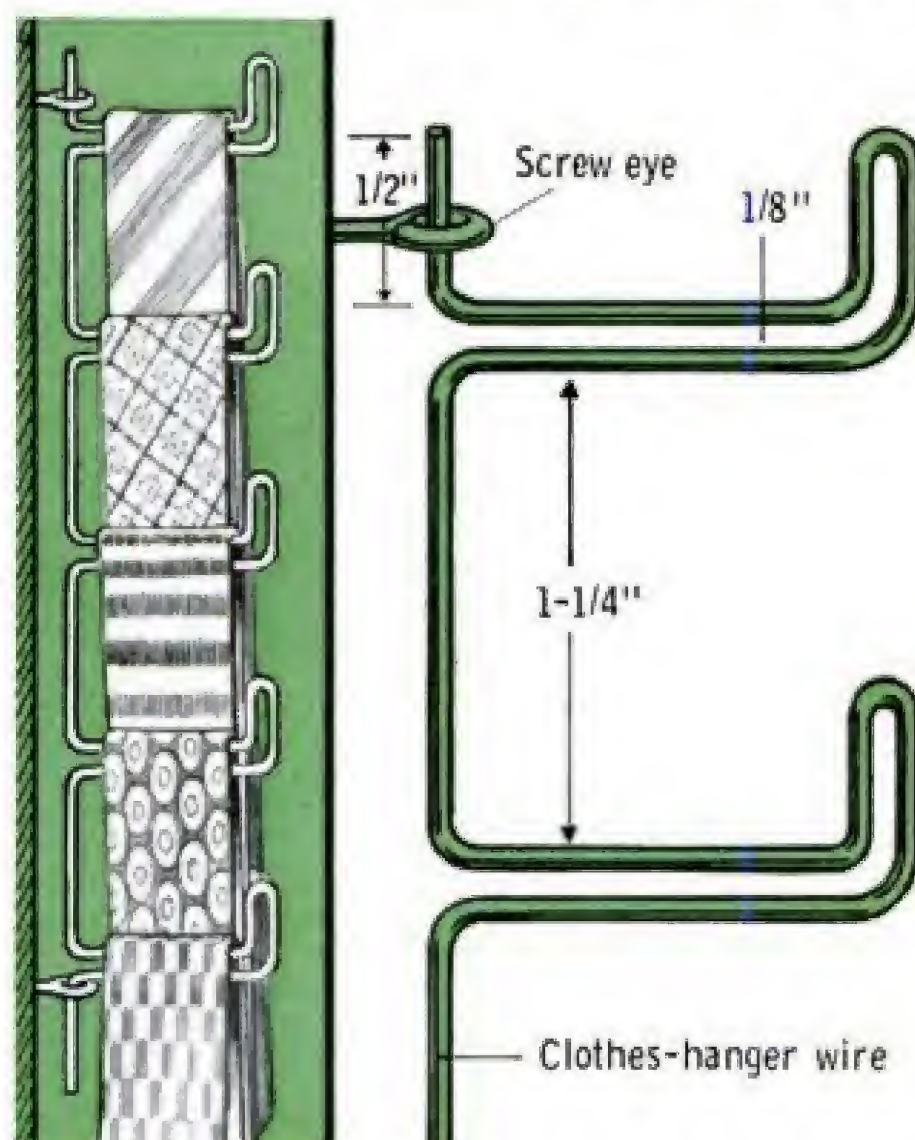
STANDING ON A LADDER for a length of time can be tiring, even when it's a stepladder. This hook-on toe rest will widen the step to provide a greater surface and make standing less tiring.—Victor H. Lamoy



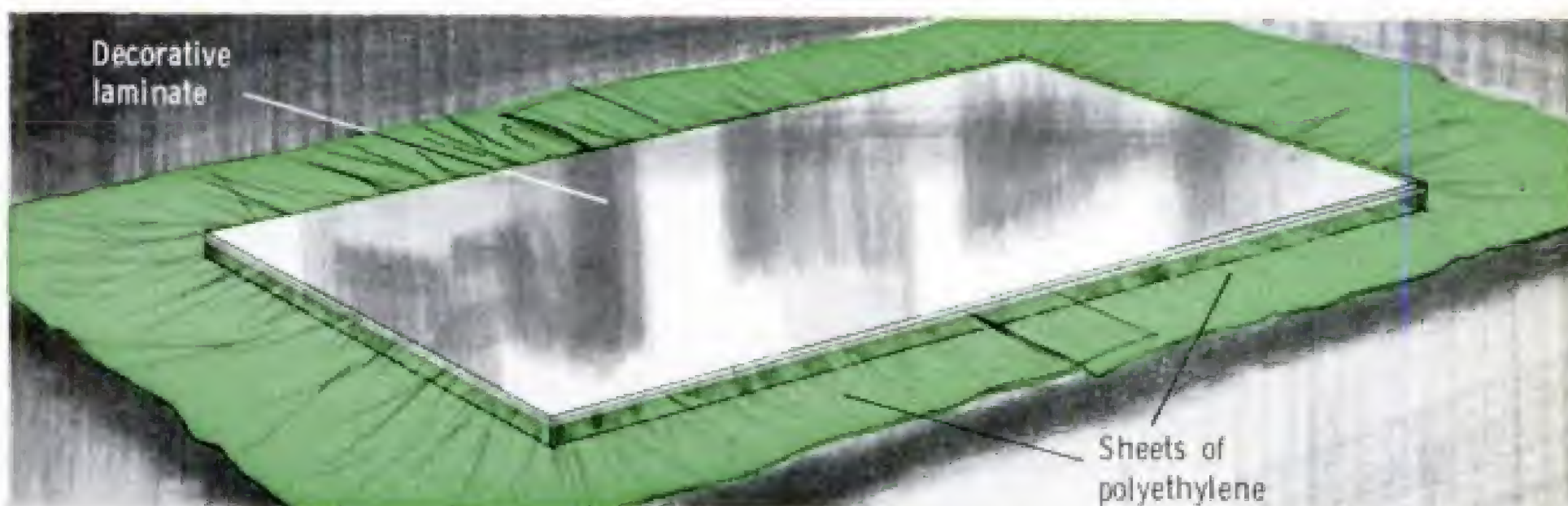
DRIVING A SCREW in an awkward place overhead presents a problem when you can use only one hand. For a simple way to hold the screw to the end of the screwdriver, use double-backed tape.—Michael Ligocki



ROLL OF STAMPS can be kept in tow as you use it with one of your wife's bobby pins used as a slip-on clamp. Spring tension of the pin is sufficient to grip the roll, yet it still permits unrolling stamps.—John Krill

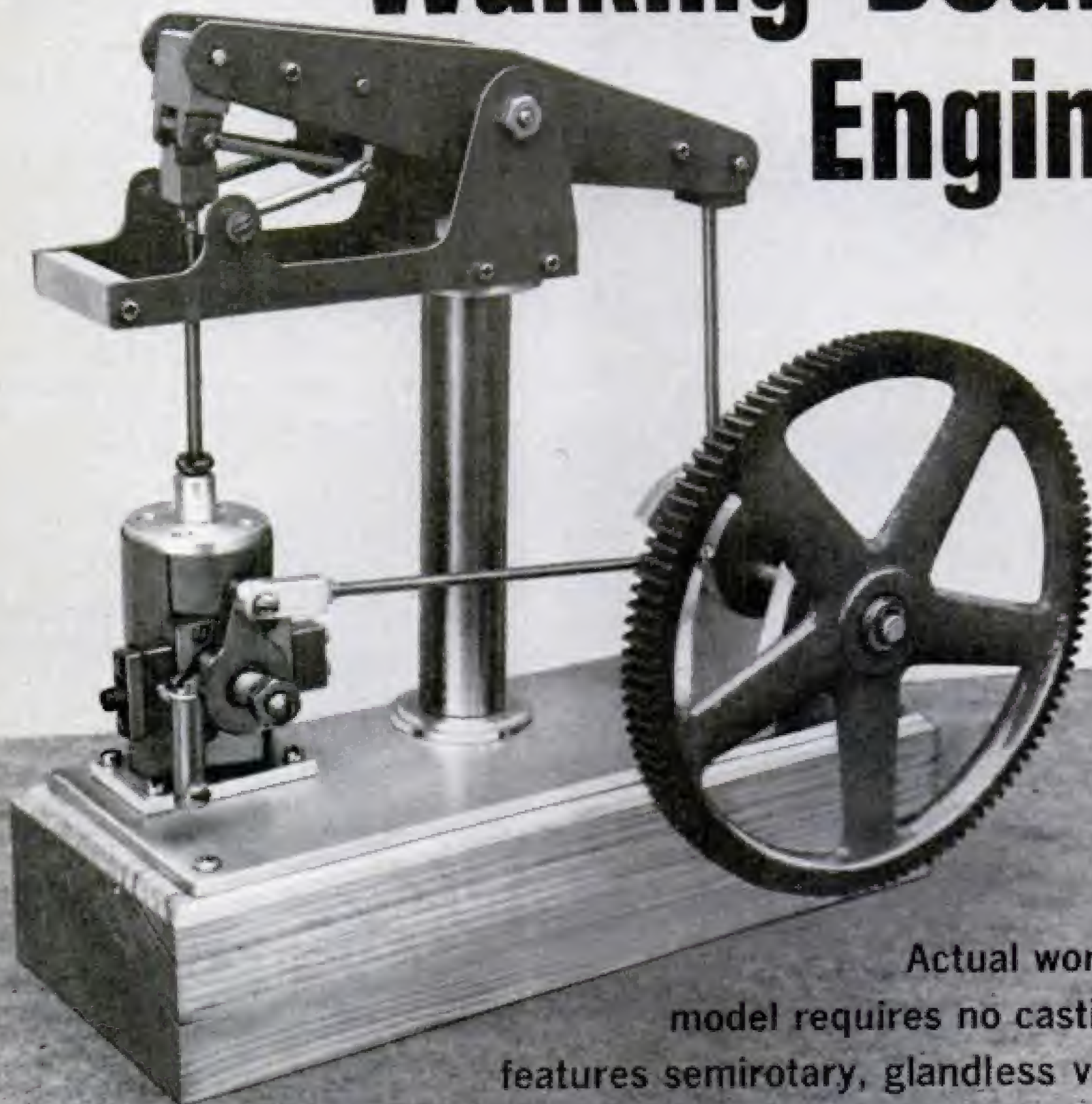


SWINGING TIE RACK, shaped as shown from coat-hanger wire and pivoted in two screw eyes, takes little space since it can fold flat against wall. Part of each tie hangs in front for quick selection.—Frank Shore



WHEN BONDING PLASTIC LAMINATE to a countertop, you'll find polyethylene is better than wrapping paper for separator sheets. The plastic sheets will pull out easily without sticking like paper.—Victor H. Lamoy

Build This Model Walking-Beam Engine



Actual working model requires no castings, features semirotary, glandless valve.

By RUDY KOUHOPT

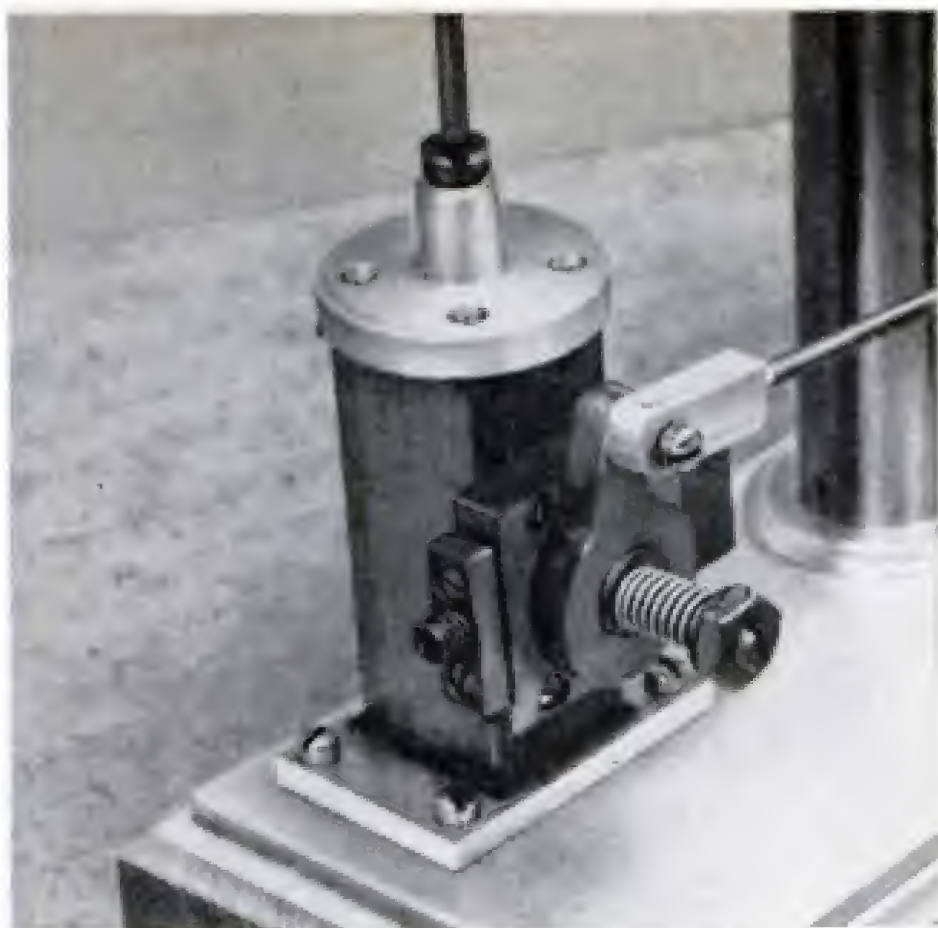
Technical Art by Fred Wolff

AS A PRIME MOVER, the steam engine came into existence over two centuries ago. From its humble beginnings, James Watt improved upon the operation of the steam engine until he raised it to the position of a great industrial and economic force. One of his innovations, the parallel link motion, functions in this captivating miniature just as Watt specified in his patent of 1784.

Briefly, this is how it works: Steam, regulated by the valve, drives the piston up and down in the cylinder in a vertical, straight line. The piston rod, likewise, travels in a straight line but is connected

to one end of the beam. This is where the parallel link motion comes in. It is interposed between the piston rod and the beam. There it converts the linear motion of the piston rod into the radial motion necessary for the beam to oscillate, or walk, about its midpoint. At the opposite end of the beam, the connecting rod drops to the crank to impart a rotary motion to the crankshaft. An eccentric mounted on the crankshaft controls the valve so that steam is admitted to and exhausted from the cylinder in the proper sequence of events. The cylinder is double action.

Begin construction of your miniature



THIN SHEET METAL is rolled in a sleeve to form an insulating lagging or cover around the cylinder

engine by cutting out the wood base and then mark out the bedplate on $\frac{1}{8}$ -in. Dural and drill the holes for the mounting screws and column. Two wood screws, through the holes in diagonal corners, hold the bedplate to the base.

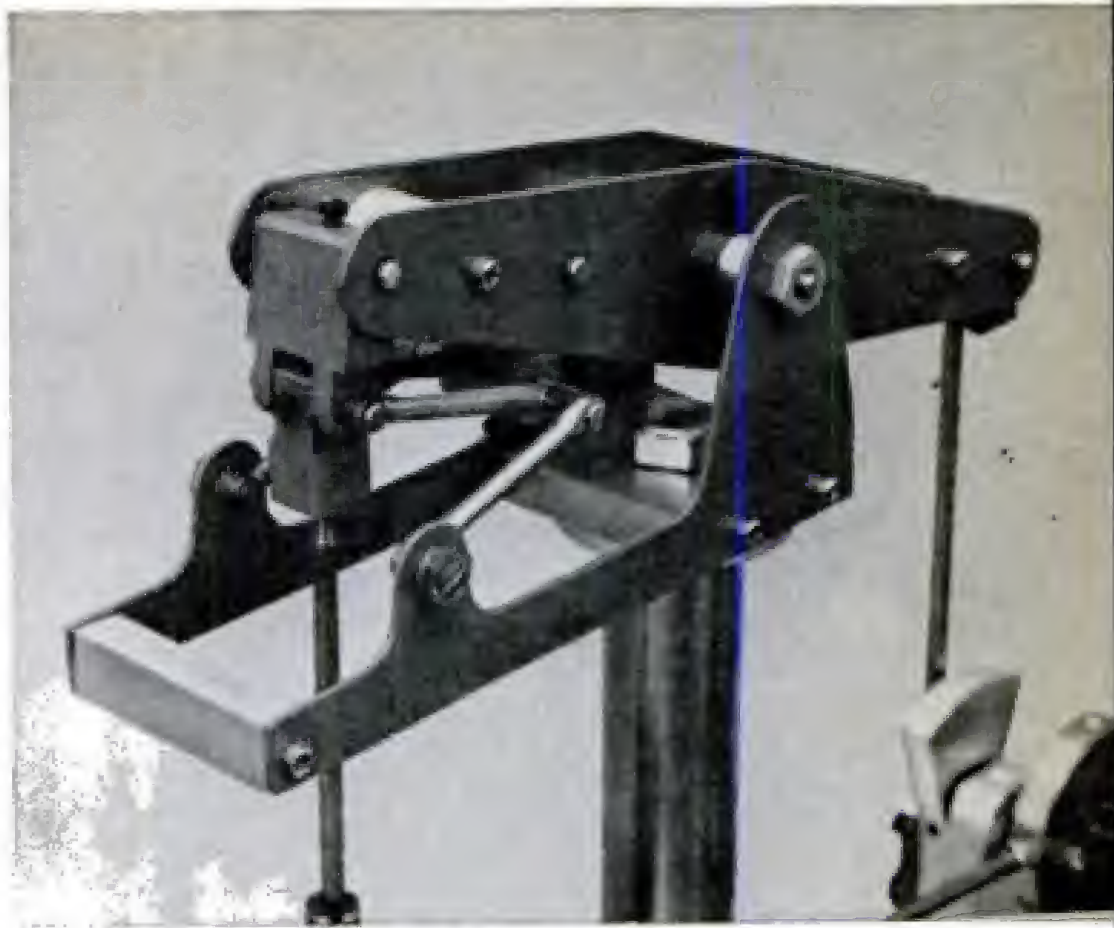
The complete column assembly is composed of the column, the two column ends, and the entablature. Machine the column first, then the ends for an exact fit. When all parts are finished, pass a $\frac{1}{4}$ x 5-in. bolt through them and anchor the assembly to the bedplate with a nut on the underside.

Next, mark out the outline and hole centers of one spring beam on $\frac{1}{32}$ -in. sheet metal. Drill it and use it as a guide when drilling the second piece. Bolt the two pieces together with 2-56 screws through the smaller holes and cut out both parts at the same time with a fine hacksaw. Finish to the mark by filing. Attach one to either side of the entablature with two 2-56 screws. Now make the stretcher and place it between the spring beam ends.

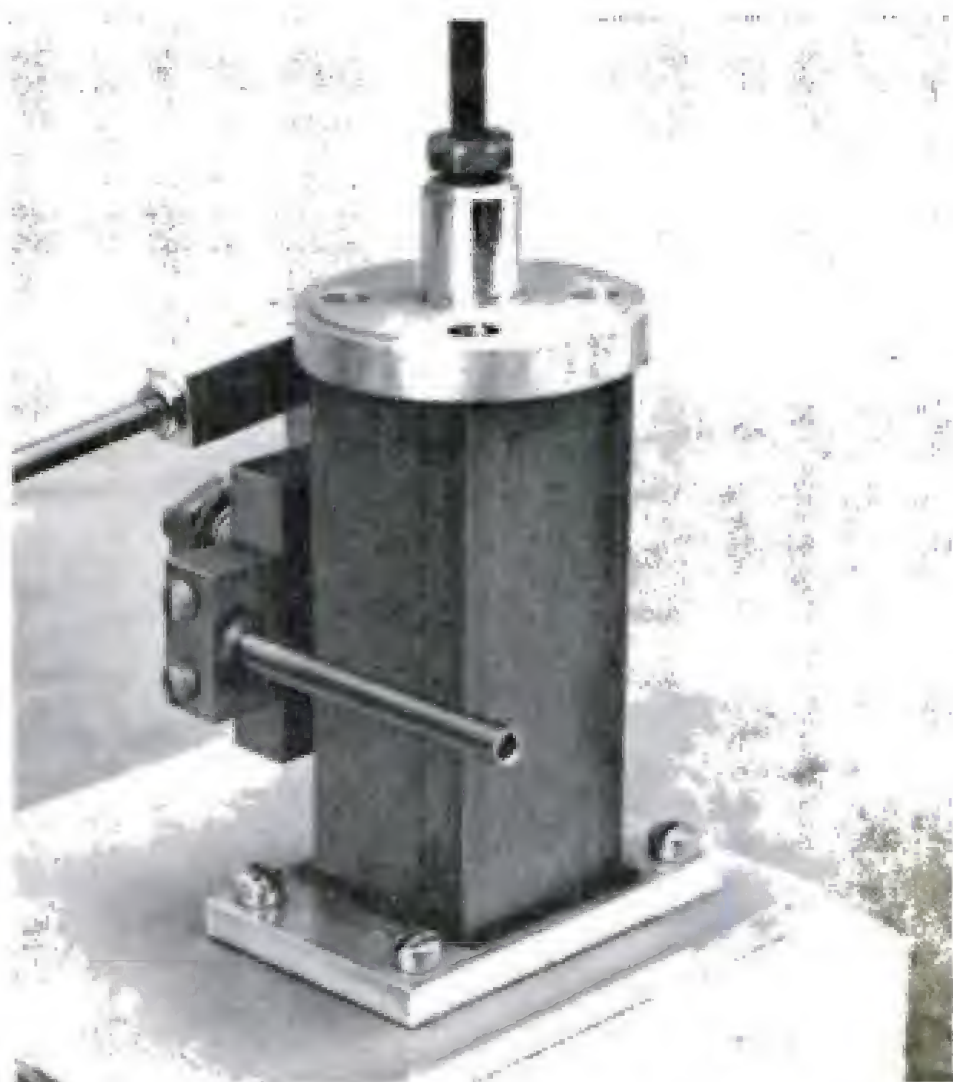
Next, make the gudgeon which spans the spring beams and acts as the main pivot for the beam. Four nuts on the threaded ends of the gudgeon hold it in place; one nut goes on each side of each spring beam. Make the two link gudgeons next. Screw one into each spring beam and add a locknut.

Follow the same basic procedure on the beam side members as you did on the spring beams. Assemble the beam by putting the shouldered ends of the center spacer through the $\frac{5}{16}$ -in. holes in the beam sides. Put the other spacers in place,

AUGUST 1969



TWO PARALLEL LINKS go between the back and main links and two more between back link and gudgeons

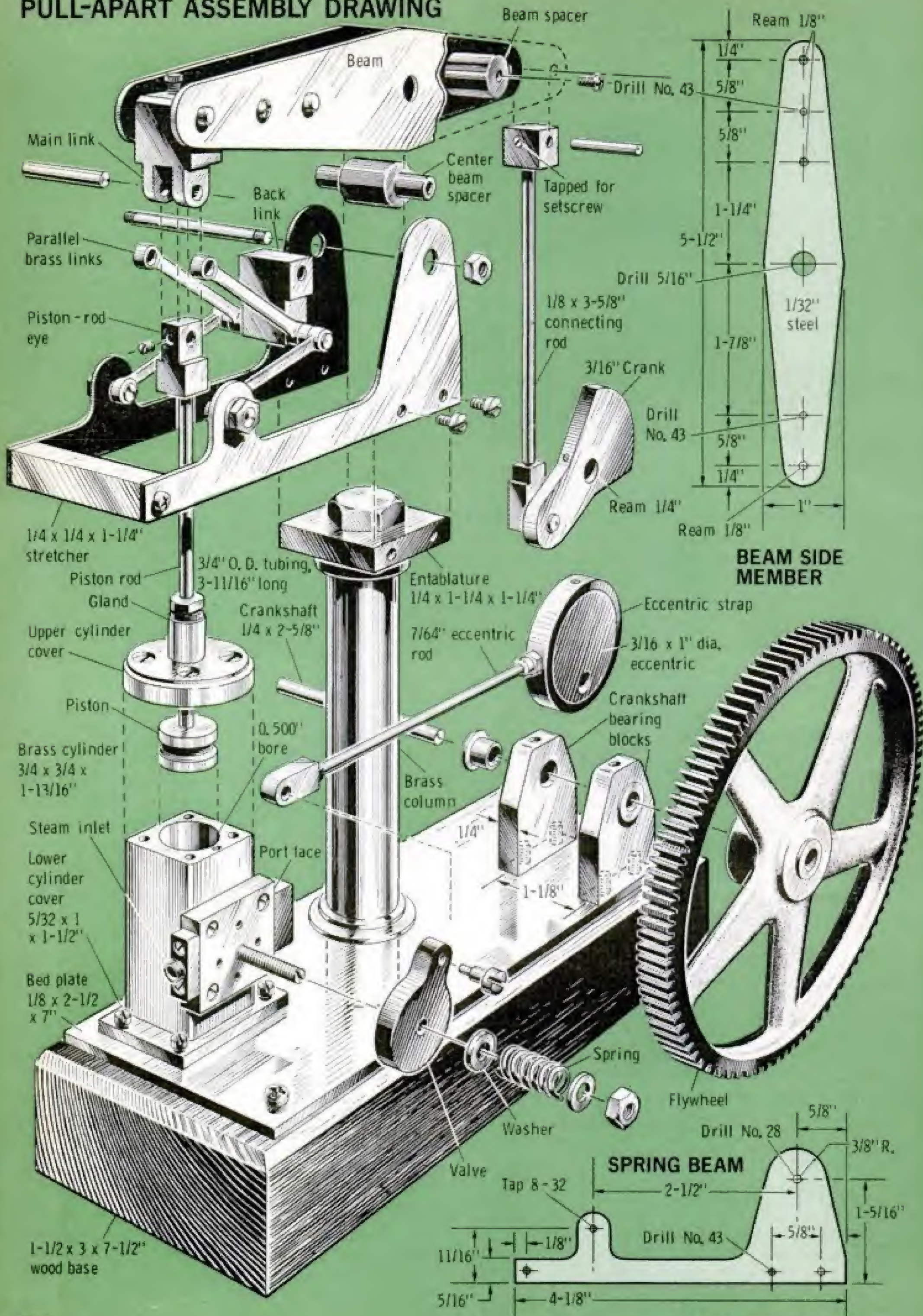


BRASS TUBING is sweat-soldered into an elbow flange to form the exhaust fitting for the cylinder

using 2-56 machine screws through the sides. The $\frac{1}{8}$ -in. openings are for the pins on which the connecting rod and links move. Mount the beam on the column by passing the gudgeon through the spacer.

Shape the main and back links as shown and install with pins made from $1\frac{3}{16}$ -in. lengths of $\frac{1}{8}$ -in. steel rod. The top screws in the links will hold the pins in place. Assemble the four parallel links on a simple jig to insure that all will be exactly the same length. The jig consists of two $\frac{1}{8}$ -in. steel pins accurately placed $1\frac{1}{4}$ in. apart in a wooden block. Cut eight pieces of

PULL-APART ASSEMBLY DRAWING



$\frac{1}{8}$ -in. i.d. brass tubing, each $\frac{3}{32}$ in. long, to form the eyes of the links. Put one over each pin in the jig, and cut a length of $\frac{3}{32}$ -in. brass rod to go between. Solder the two eyes and the rod together. Remove from jig, and repeat until all links are done.

Cut $1\frac{1}{32}$ -in. and $\frac{3}{4}$ -in. lengths of $\frac{1}{8}$ -in. steel rod to form the lower pins in the back and main links, respectively. Spacers about $\frac{1}{8}$ in. long must be placed between the parallel links on the lower pin of the back link. Exact size of the spacers and setting of the link gudgeons must be determined individually so the beam will swing freely and evenly.

Cut a $3\frac{5}{8}$ -in. length of $\frac{1}{8}$ -in. steel rod for the crankshaft connecting rod and add the big and small ends. After assembling the three parts, install the assembly in the beam by passing a pin through the beam and the transverse hole in the big end. The pin is a $1\frac{1}{16}$ -in. length of $\frac{1}{8}$ -in. steel rod.

Shape the crankshaft bearing blocks as shown, and mount them on the bedplate with 4-40 screws from the underside. Use bronze bearing stock for the crankshaft bearings which should be a light press fit in the blocks. Pass a $\frac{1}{4}$ -in. reamer through the bearings after mounting to be sure that all is well aligned.

Turn the crankshaft between centers for the best job, then make the crank and crankpin and mount them on the crankshaft. Put the crankpin through the small end of the connecting rod and adjust its length by the setscrews.

Its length must be such that the beam is horizontal when the crank is at mid-stroke. The beam ends must move symmetrically, $\frac{5}{8}$ in. above and below the horizontal, when the crank is at either end of the stroke.

Use a block of $\frac{3}{4}$ -in. square brass for the cylinder. Set it up in a four-jaw chuck, face the ends to bring it to length and mark the center of the ends. Start the bore with twist drills, bringing it up to about $\frac{7}{16}$ in. The bore can be finished in several ways, including the use of a sharp parallel reamer. My favorite method is to use a between-centers boring bar with the cylinder mounted on the lathe saddle. Block the cylinder up and clamp it so its center coincides with the axis of the lathe. Feed the work slowly on power feed, increasing the bore a little at a time. This method will produce a cylinder in which



THE ECCENTRIC STRAP must be a good running fit on eccentric with retaining screw loose in the groove

the walls are absolutely parallel throughout their entire length.

With the boring complete, mark out the two steam passages on the midline, $\frac{39}{64}$ in. from either end. Drill these punch marks $\frac{3}{64}$ in. deep with drill No. 52. Mark the ends of the cylinder where the steam passages come out half way between the cylinder bore and outer wall. Drill $\frac{5}{8}$ in. deep from either end with drill No. 52 to form the complete passages which will be L-shaped at this point. Use a small file or end mill to remove about $\frac{1}{32}$ in. of the wall between the end of each passage and the bore to give free entry of steam.

Mark the locations of the four screws which will hold the port face to the cylinder, then drill $\frac{3}{16}$ in. deep, and tap 2-56.

Cut a 1-in. square of $\frac{1}{4}$ -in. brass for the port face. Accurately locate the center as a reference point. Working from the center, locate the four steam ports. The two ports on the vertical centerline are drilled No. 52 right through to meet the passages in the cylinder wall. The two ports on the horizontal centerline are drilled No. 52 to a depth of $\frac{1}{8}$ in.

Connecting passages are drilled on the horizontal centerline from each side to serve as steam inlet and exhaust. Mark out and drill locations of the four mounting screws, then counterbore to form re-

(Please turn to page 202)

Weekend Workshop



PIVOTING BLOCKS hold legs rigid in an open position by wedging against leg's cross rail

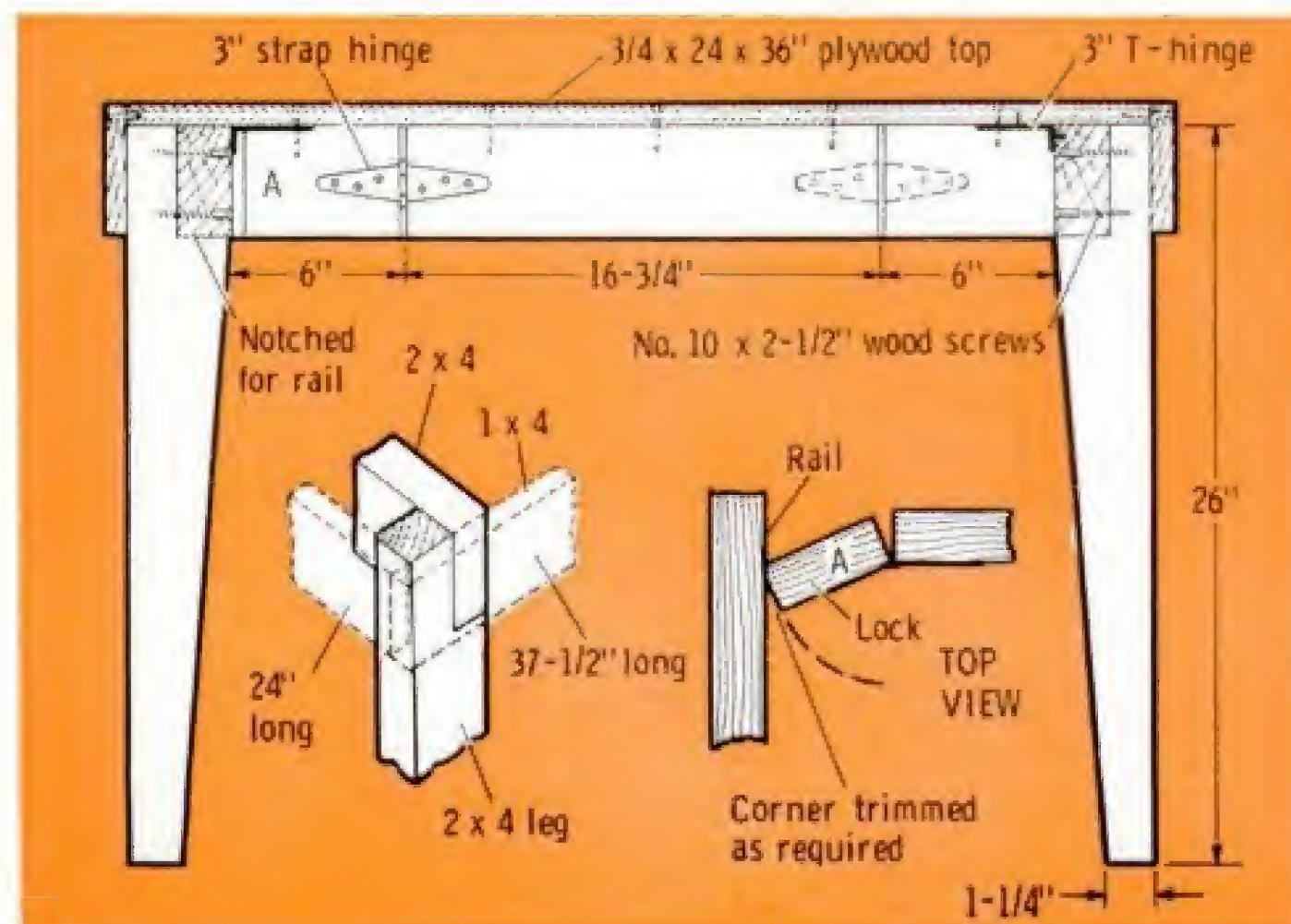
Kid's play-work table

When a rainy day keeps youngsters penned inside, that's when a play table like this comes in handy. It's just the thing to stand at for cutting, pasting and painting; no one cares how messy it gets. Best of all, the legs fold inside so you can stow the table in 5 in. of space.

The underside view shows how the hinged leg assemblies are offset to nest

alongside each other when folded, and also shows how the hinged leg-locking blocks "store" in the folded position.

You can change the size of the top if you wish but keep the legs 26 in. For tykes the legs can be 18 to 20 in. The top is plywood, the skirts are 1x4s and other pieces, 2x4s. T-hinges are used to hinge the legs, strap hinges to pivot the locking blocks. Note that the latter hinges are on opposite sides.—*R. S. Hedin*



UNDERSIDE VIEW shows legs and twin locking blocks nested in top when folded

POPULAR MECHANICS

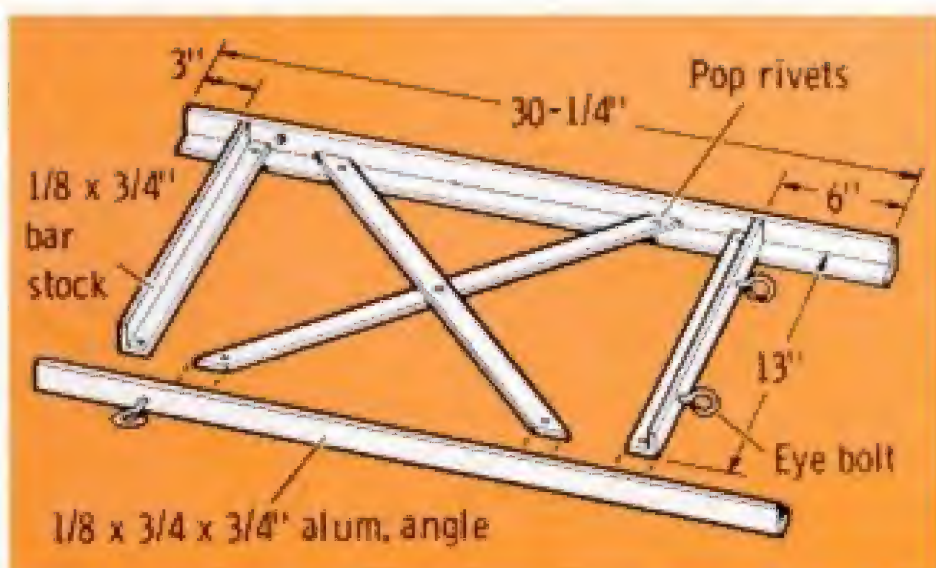
Projects

Aluminum pack frame

When it comes to backpacking heavy gear like tents and sleeping bags, nothing works so well as a pack frame. This aluminum one accepts a standard-size packsack or lets you lash the load to it.

Follow the drawing in making it from Reynolds do-it-yourself aluminum and use a Pop Rivettool to put it together. Then round all sharp edges with a file.

The shoulder straps and back bands may be canvas or nylon webbing. The straps are attached to $\frac{1}{4}$ -in. eyebolts spaced 5 in. apart in the top member. The bolts are left loose to turn with the straps by peening the ends. At the lower end, the straps are secured to eyebolts in the sides. The back bands are located so the upper band is behind the shoulder blades and the lower one is in the small of the back.

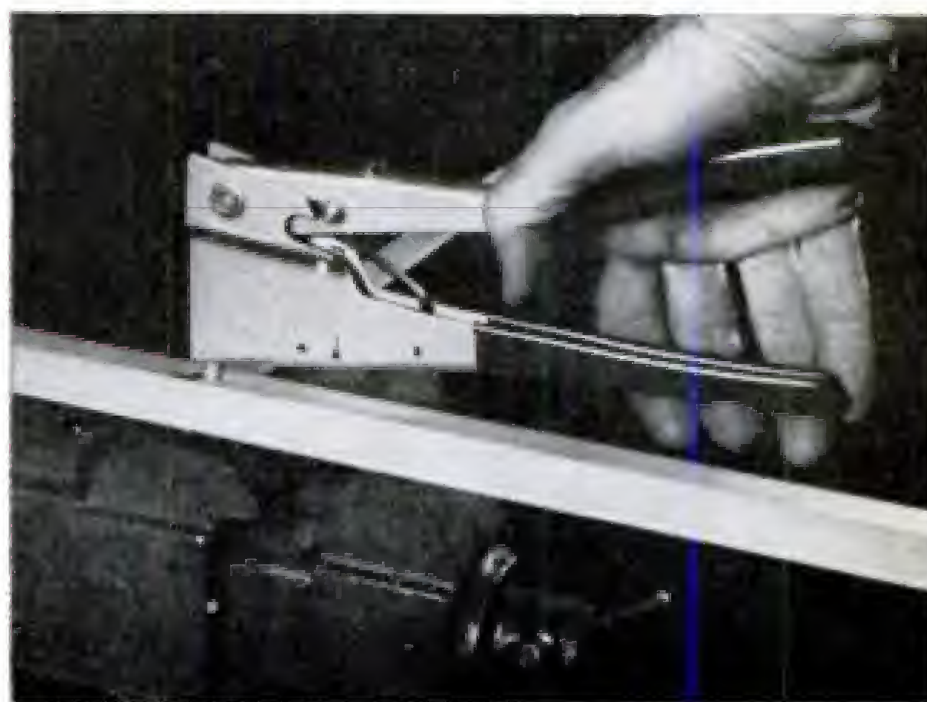


BANDS ARE LACED as shown. Upper band is placed behind shoulder blades, lower one is in small of back

AUGUST 1969



SHOULDER-STRAP EYEBOLTS should be left loose to swivel. Shorten bolts and peen ends to lock nuts



POP-RIVET FASTENERS provide quickest and neatest method of fastening six aluminum frame members

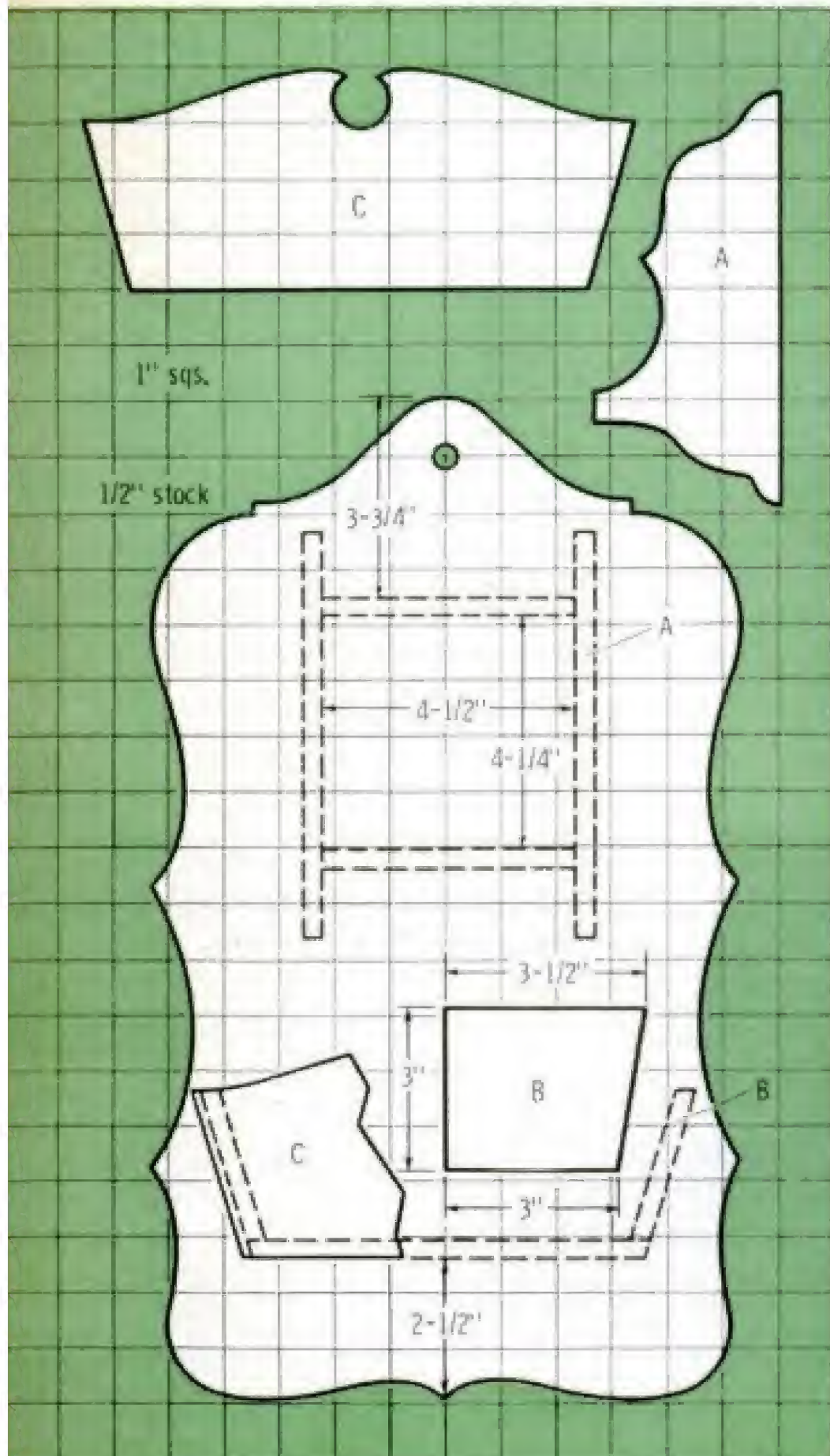
161



Early American clock-planter

If you have cast aside an old, yet serviceable, alarm clock for a modern clock-radio, you can find new use for it as a wall clock in this handsome Early American piece. A shelf at the top holds the clock and a trough at the bottom holds a plant.

Make paper patterns of all the parts and trace them on $\frac{1}{2}$ -in. material. Cherry, pine and walnut are appropriate woods. Chances are you'll have to glue up the $10\frac{1}{4}$ -in. back from two or more pieces to build up the width. Simple butt joints are used throughout; screws from the back attach the clock shelf and the planter. If you happen to own a router, you can add a finishing touch to the project by shaping the edges of all parts before assembling. A Styrofoam block in the planter will hold plastic plants.—Don Shiner



POSITION THE CLOCK SHELF $3\frac{3}{4}$ in. down from the top and attach it to plaque with flatheaded screws



BAND OR JIGSAW makes quick work of sawing out plaque and the three other scroll-cut parts required

POPULAR MECHANICS

HINTS FROM READERS

Unplug that tube—easily

Once you snip the tip on a caulking cartridge, any leftovers will soon cake the spout if you don't plug the end. A flathead nail makes about the best plug you can find since it's long enough to extend all the way into the cartridge and its head is easy to grip and pull out. The nail keeps a hole free of caulk the full length of the spout.—*Anthony S. Walters*



Quickie letter holder

A few parallel saw kerfs, $\frac{1}{2}$ in. deep and 1 in. apart, cut lengthwise in a block of fine cabinet wood make it an instant letter holder. If the edges are shaped and the wood given a couple coats of a self-rubbing finish, the holder can be an attractive desk accessory. A $\frac{3}{4}$ x 7 x $10\frac{1}{2}$ -in. block is about right. Some of the kerfs can be wider than others.



Fishline locks machine screws

Regular self-locking machine screws have a slot milled in the shank for a nylon pellet. The resiliency of the nylon exerts constant pressure against the nut, thus keeping it from working loose. Practically the same self-locking feature can be obtained with any bolt by first inserting a piece or two of nylon fishline in the hole.

—*Robert G. Lanzit*



Extra use for bulb holder

The throwaway holder you get with GE miniature flashbulbs can be put to good use as a holder for pins, small screws, cotter pins and the like. You'll find the slit plastic holder ideal for holding a supply of bank pins used in modelmaking. Ordinarily difficult to pick up, the pins are simply slid off the end of the tube as needed.—*Joseph Braunstein*

Gear shaves wood dowel

The next time you want to reduce the diameter of a wood dowel or taper it to form a handle for a small tool, try using a steel gear as a shaving tool. Simply clamp the gear in the vise and pull the dowel between two teeth, so that the sharp corners will shave the wood. When the gear gets dull, resharpen it by filing across its flat surface.—*Walter E. Burton*



Build This Handsome



KEEPING BOOKS HANDY is no problem in this clever desk which features its own built-in bookcase. Pigeon-hole compartments in the base hold dozens of books within easy reach, and their weight helps to make the desk's cantilevered top exceptionally sturdy. A wrought-iron leg supports its outboard end, and there's a shallow but roomy drawer at the top of the book compartments. The desk-top is a standard flush door which is cut down to a 4-ft. length and covered with slick countertop plastic.

Cut the various pieces to the sizes given and assemble them in the following order, using glue and 2-in. finishing nails. First nail side A to bottom B. Then add divider C. Follow with divider D, middle shelf E and dividers F and G. Next add top pieces H and I, followed by J. Finally, install parts K and L. Set the nailheads below



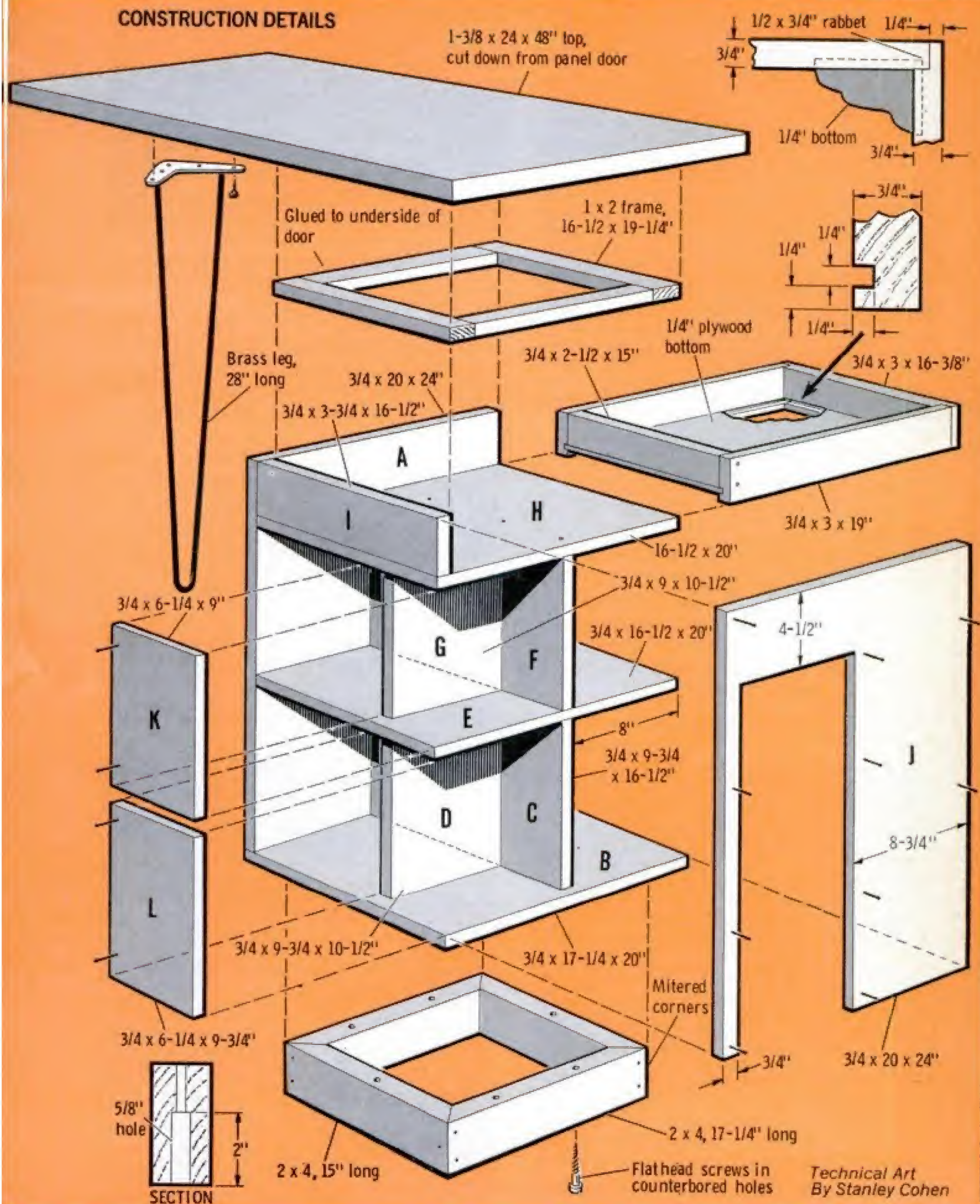
DESK IS DESIGNED to be placed at right angle to wall to make its bookcase accessible from all sides

POPULAR MECHANICS

Bookcase Desk

By ALVARO ALTOMARE

CONSTRUCTION DETAILS





SHALLOW DRAWER is made to fit compartment. Side clearance, plus wax, will make drawer slide freely

plastic on top. This lets you shift the plastic without fear of it sticking. When you have it where you want it, pull out one of the papers and press down. Pull out the others and go over the whole top with a block and hammer. Finish up by filing the overhanging edges flush with the edge banding, first using a sharp plane and finishing up with a file. Watch that you don't scratch the edges.

The top is attached to the bookcase base by a 1x2 frame made to fit the well above the drawer space. The frame is glued to the underside of the desktop. Typical drawer joinery is followed in assembling and fitting the drawer. ★★★

TOP IS JOINED to bookcase section by frame that's glued to underside. Frame, in turn, is glued to case



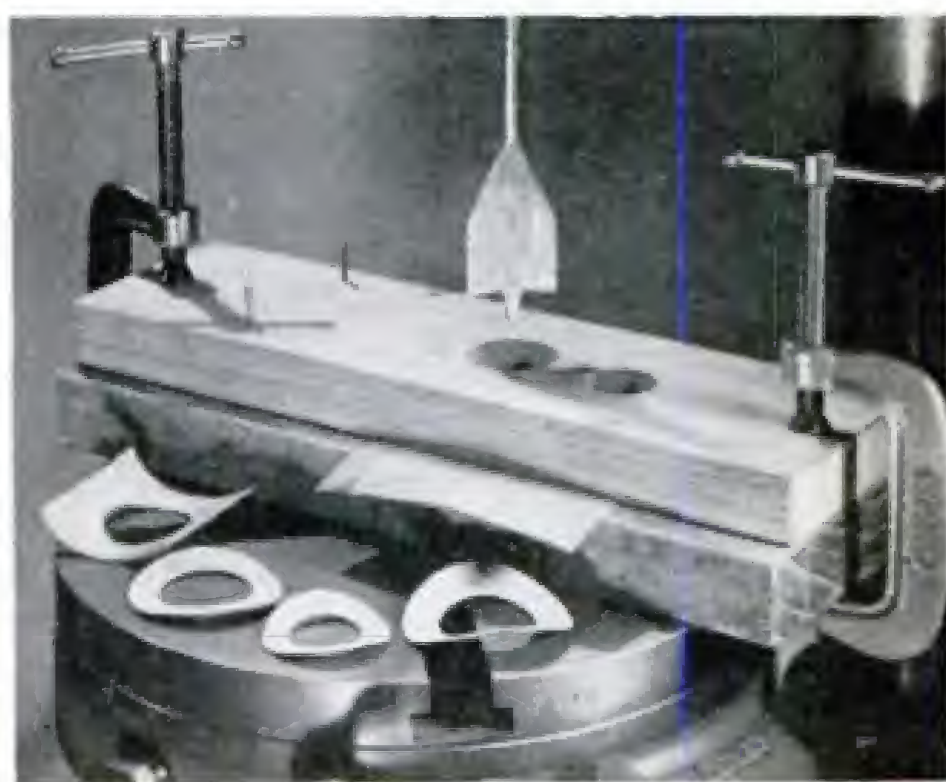
AUGUST 1969

HINTS FROM READERS



Plastic bag is layout aid

When you do layout work on small pieces of polished metal or plastic, many scratches can be avoided by slipping the material inside a plastic sandwich bag. You'll have no difficulty seeing through the plastic, and it's thin enough to be pierced easily by scribes, dividers or punch. You can protect large work in the same manner by taping roll plastic to the top of the material.—*Herbert Y. Moon*



Ring gaskets by the dozen

An easy and accurate method for cutting the inside hole when making small ring gaskets is to sandwich the sheet cork between two blocks of wood and bore all three with a wood bit in a drill press. After drilling, cut the outside of the gasket with scissors. A couple of nails will keep holes in the blocks in register and still let you slip in the cork when making duplicate gaskets.—*Wilbur H. Fulker*

EXCITING NEW PRODUCTS

By CATHERINE BILSKI



HIGHWAY EMERGENCIES are easier for you to handle if you're prepared for them with this Highway Safety Kit. It contains a 60-second tire inflator and puncture sealer, a U.L.-approved disposable dry chemical fire extinguisher, a "Help" flag, two fusee emergency flares and eight Wash n' Dry towelettes. The 14-piece kit (TK-3) sells for \$12.50 and is made by BernzOmatic Corp., 740 Driving Park Ave., Rochester, N.Y.



PORTABLE PUMPING SYSTEM that offers power in a compact size that's ideal for homeowner use is the Mini Vac. The high-rpm electric motor and 250-gallon-per-hour pump will lift water 20 feet straight up. The system, which includes a pump, motor and 12 feet of input-output hose fitted with standard plugs, sells for \$39.95. It's manufactured by the Simer Pump Co., 207 Humboldt Ave. North, Minneapolis, Minn.



HERE'S THE ANSWER to your changing storage needs. Have additional space whenever you need it with the Add-A-Drawer Chest. Individual drawers stack to any height and lock together to form a single solid chest. Finished in handsome walnut wood grain, the corrugated fiberboard construction is reinforced with a rigid steel frame to assure ample strength for any storage need. Drawers slide in and out freely even when fully loaded. Manufactured by Safo Products Co., 7425 Laurel Ave., South Golden Valley, Minn.

FIX THAT FLAT fast and easy with the Trailer Jak, a simple one-piece mechanism. When it is placed under the axle of a flat-tired trailer and the car moved forward one foot, the Trailer Jak rocks to an "up" position and rests on its 28-sq.-in. base. Adjustable for many different heights of axles by merely changing a bolt and wingnut to a different set of holes. It's priced at \$9.95. Made by Central Specialties Co., 6032 Northwest Highway, Chicago, Ill. 60631.





DRY-COATING LUBRICANT called Emralon 327 adds a slick surface to your table saw and jointer, makes windows and drawers slide without binding, even keeps snow from sticking to shovels. Comes in 4 and 16-ounce spray cans, air-dries to touch in five minutes, is fully hard in two hours. Four-ounce can has handy extension tube for lubricating sliding tracks of aluminum windows. Available from Colloids Co., Port Huron, Mich.



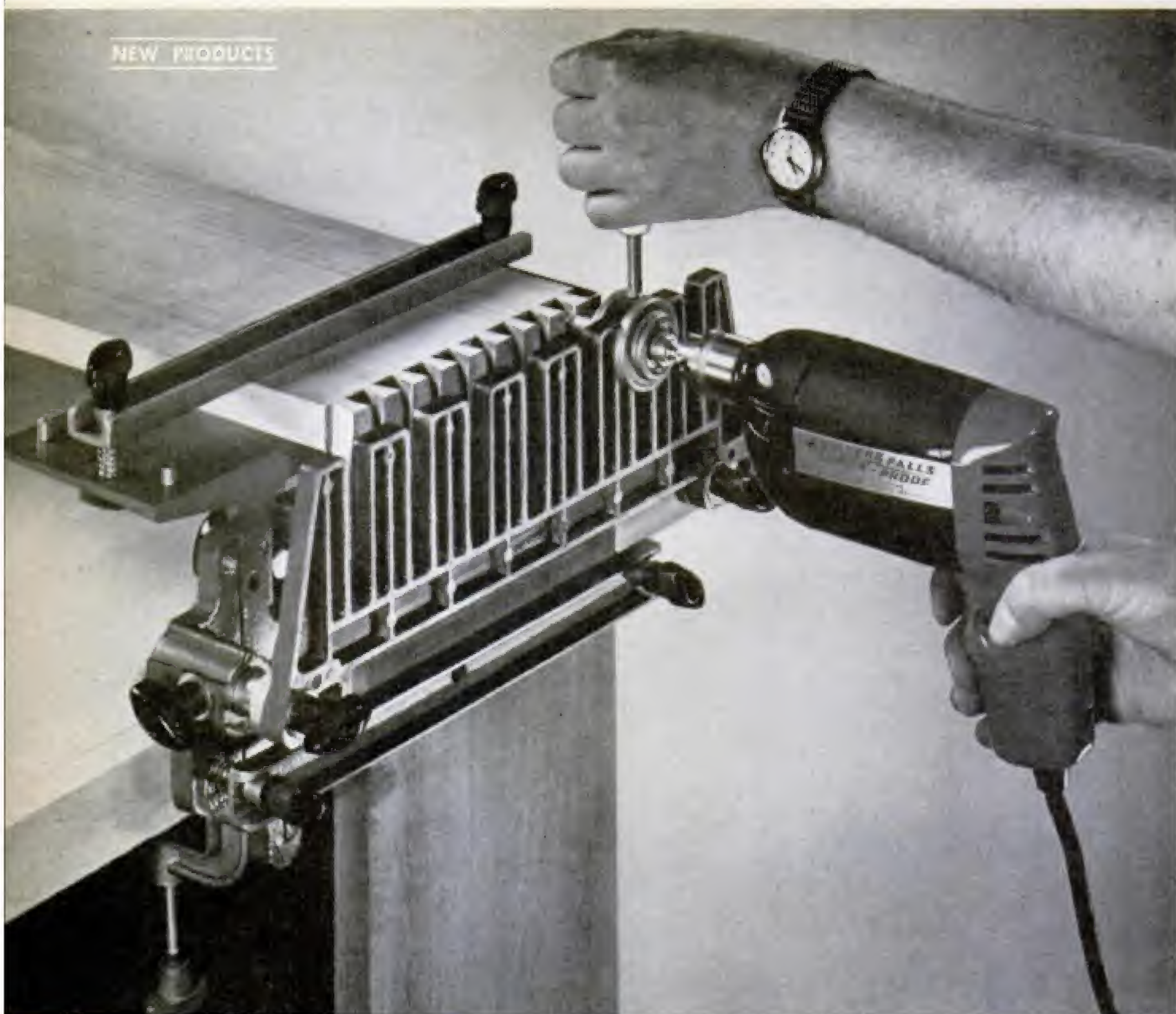
FOR SPECTATOR COMFORT, this folding stadium seat is designed to be either portable or permanently installed. It has spring-loaded locking clamps which hook over edge of any bleacher-board seat, and comes upholstered in red or green all-weather vinyl. Fitted with snaps, the seat is easy to remove. Its hinged back will support 300 pounds. \$7.95 postpaid from C. A. Bittner, Dept. P-5, Box 4732, Inglewood, Calif. 90302.



EXTENSION-CORD POWER BLOCKS provide a four-in-one receptacle for plugging in several power tools or photo-flood lamps. The No. 381 model features two parallel-blade duplex receptacles; No. 385, two three-wire, U-blade duplex receptacles. Each unit, rated at 15 amperes and 125 volts, comes with handy snap-on hook for hanging, and measures only $1\frac{3}{4} \times 4\frac{1}{2} \times 4\frac{1}{2}$ in. They're wired with two and three-conductor, No. 16 cables in four different lengths. Made by Rodale Manufacturing Co., Inc., Sixth and Minor Sts., Emmaus, Pa.



NO MORE OVERWATERING or underwatering. With the Melnor Water Timer you set it for the exact amount of water your lawn needs and it shuts off any sprinkler automatically when watering is done. Delivers up to 750 gallons per setting. Water Timer No. 100 sells for \$6.49. Melnor Industries, Moonachie, N.J. 10070.



Here's a Dovetailing Device

Routers are used with most dovetailing jigs but with this one a portable drill does the cutting

By JOHN BURROUGHS

MADE IN ENGLAND, this unusual tool was designed as an accessory for Arcoy's high-speed Buccaneer drills, which turn at 3000 rpm. Although most U.S.-built drills aren't geared to that high a speed, any fairly high-rpm $\frac{1}{4}$ -in. drill, and the higher the speed the better, will drive the dovetailer's cutter satisfactorily.

The three cutters supplied—short, medium and long—blind-dovetail lumber from $\frac{3}{8}$ to 1 in. thick. These bits have short threaded shanks that screw into a

cutter head, which is simply a stub spindle turning freely in a bearing set in a grooved mount. With the cutter head's spindle inserted in the drill's chuck, the rotating cutter can be guided down slots in the jig's comb with the head's handle.

The cutter carves out matching tenons and mortises simultaneously. The two pieces of lumber to be dovetailed are securely clamped face-side down, ends lapped, to the jig's right-angle plates. Registration pins on the plates offset the two pieces $\frac{3}{8}$ -in., or one-half the dove-

tail's $\frac{3}{4}$ -in. pitch. Then the comb, which mounts on studs, is set against the vertical board.

The comb shifts sideways, mounting in either of two positions, and each position cuts alternate dovetails. First the comb is set in one position and the cutting head is run down each slot; then it's shifted to the other position and the cutter head is again run down each slot. A depth-of-cut setting on the comb adjusts the dovetail's tightness of fit.

When the dovetails have been cut, the work is unclamped and the backs of the

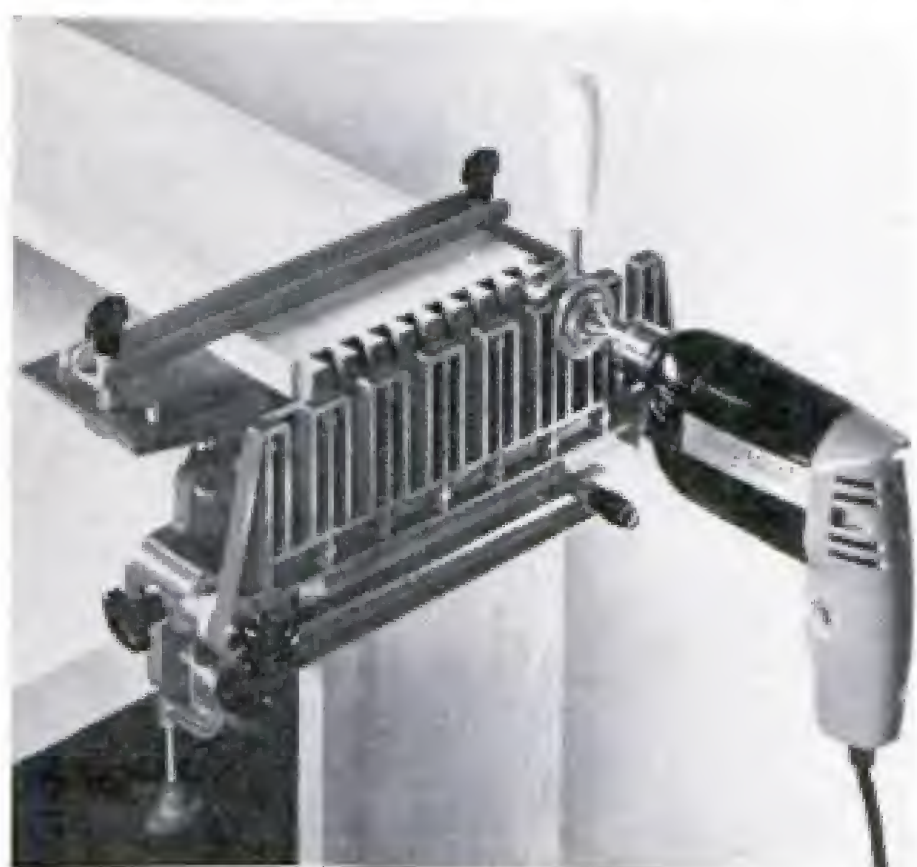
tenons are rounded off, or simply chamfered, by hand with a knife before the joint is assembled. This is necessary since the cutter does not automatically round the tenons as in the case of a regular dovetailing fixture.

A substantial tool, the all-metal dovetailer has machined die-cast angle plates with heavy channel clamps that hold lumber up to 9 in. wide. The cutters can be resharpened. The cutter head slides smoothly in the comb's slots.

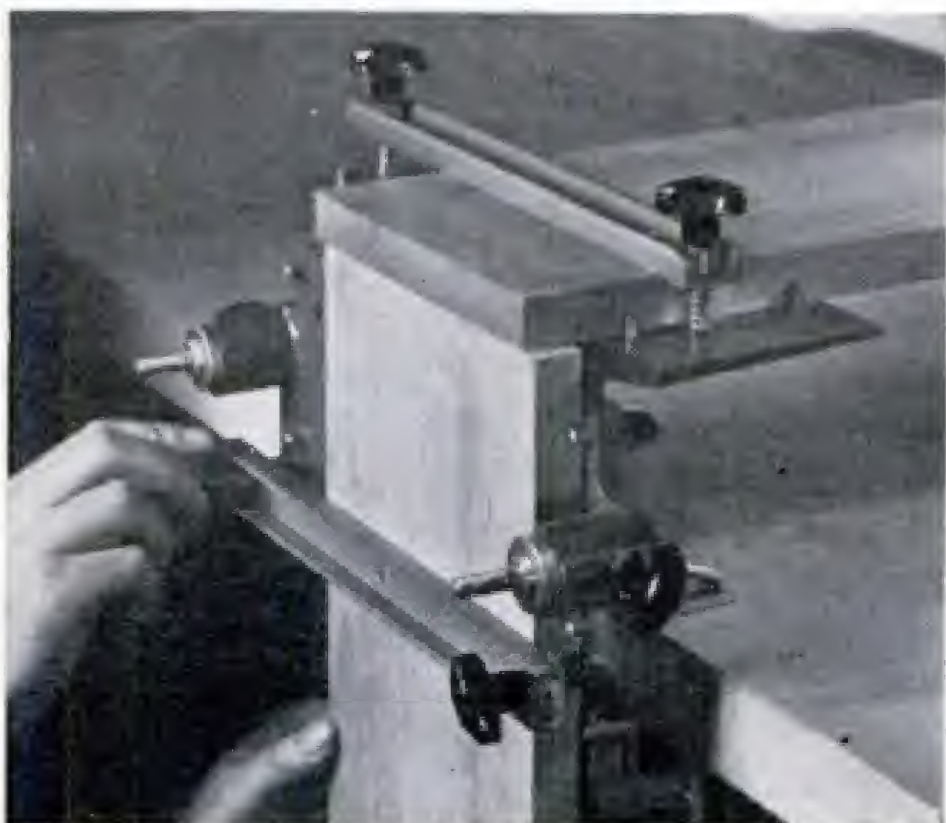
The drill-driven cutters, however, do not cut as cleanly as high-speed router

PORTABLE DRILL that turns up to 3000 rpm does the smoothest job, but any ordinary $\frac{1}{4}$ -in. drill can be used if you apply the cutter with slow, even feed

THREADED-SHANK CUTTERS screw into a cutter head that slides in the comb's slots. The three cutters furnished dovetail boards from $\frac{3}{8}$ to 1 in. thick



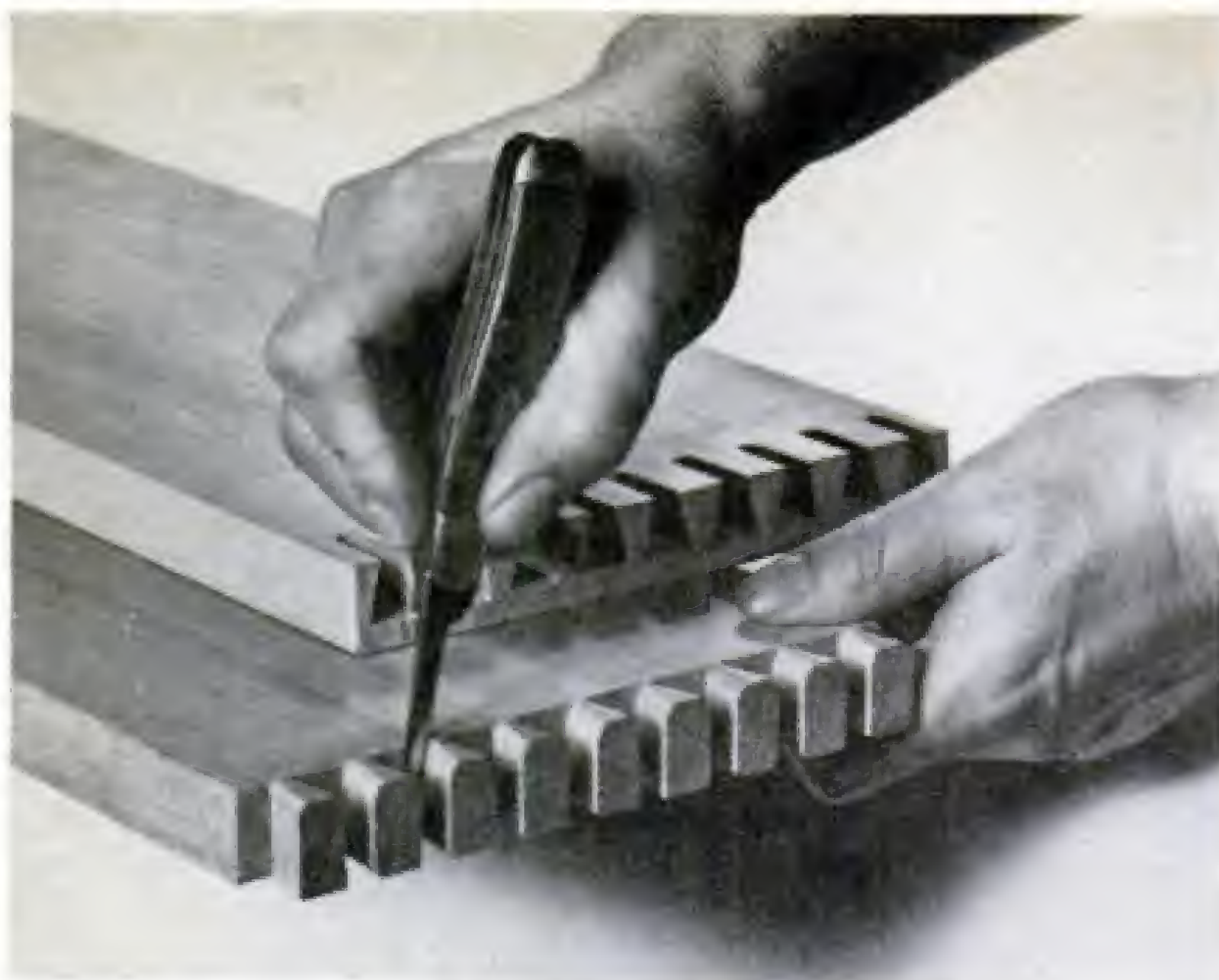
That's Really Different



WORK TO BE DOVETAILED is clamped to the jig's angle plates and against registration pins which offset the boards $\frac{3}{8}$ in. Lumber ends must be square



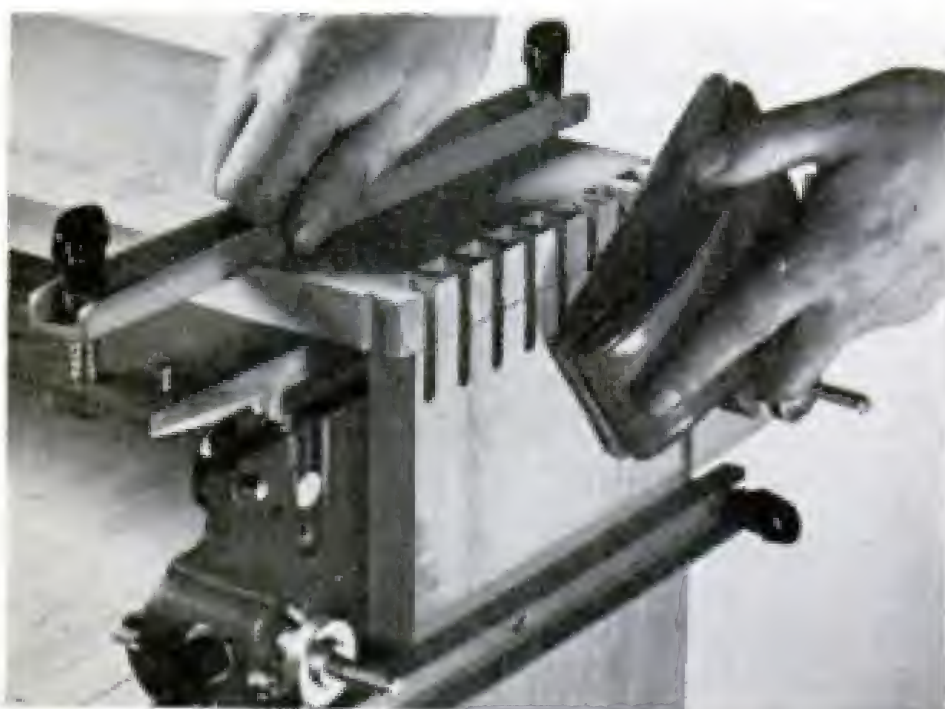
COMB GUIDE SHIFTS SIDEWAYS and locks in either of two positions, with each position cutting alternate dovetails. Slots in the comb have $1\frac{1}{2}$ -in. spacing



CUTTER DOESN'T ROUND the backs of the tenons. They must be rounded by hand with a knife to fit rounded mortises made by cutter



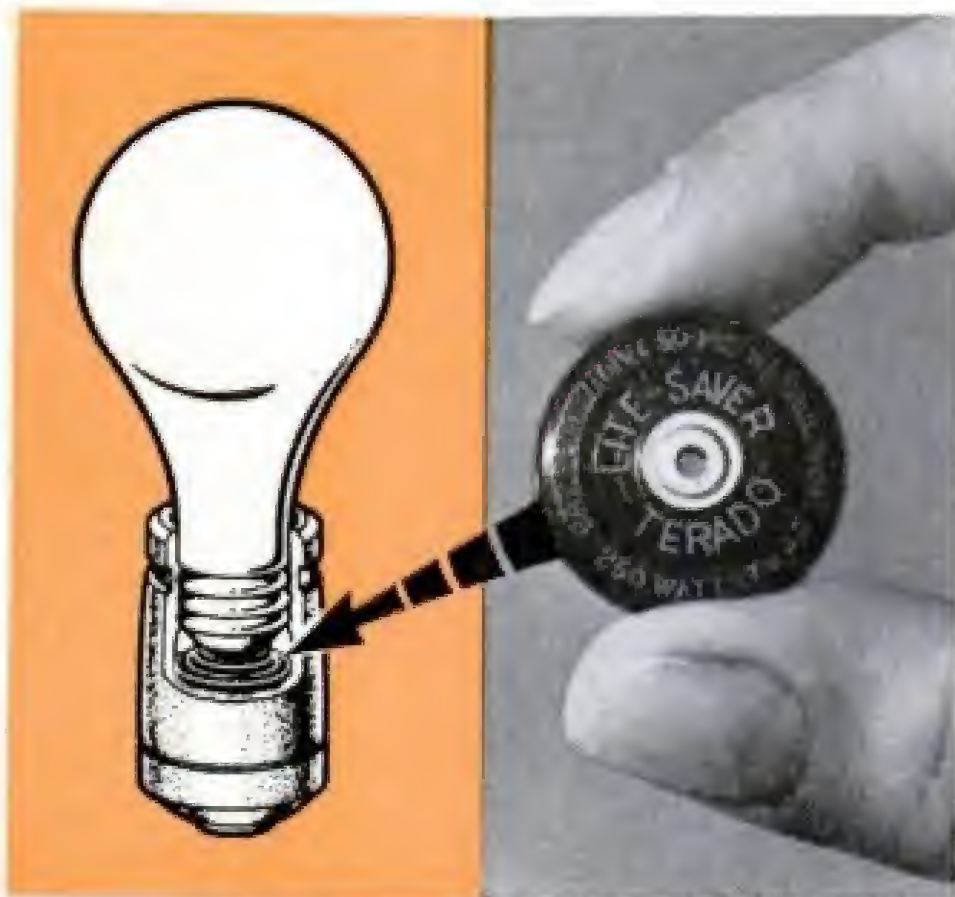
DOVETAIL TENONS have the standard pitch: $\frac{3}{4}$ -in. center to center



APPLY CUTTER to comb with slow, even feed. A little sanding with block removes the fuzz and splinters

bits, and when you're dovetailing softwoods, the cutter head must be run into the comb's slots with firmly controlled slow feed, and without side-to-side wobble, to prevent the bit from digging in and splintering.

New to the American market, the dovetailer (without drill) retails at \$39.95. An attachment for cutting housing joints (dovetails running lengthwise) and a multi-pitch attachment (for dovetails with other than standard $\frac{3}{4}$ -in. pitch) are available for the tool. Address inquiries to the importer, the Hargay Co., 3570 Warrensville Center Road, Shaker Heights, Ohio 44122. ★ ★ ★



Wafer increases lamp life

Tired of periodically replacing burned-out light bulbs? Lite-Saver, placed face down in the socket, extends 800-hour lamp life of regular incandescent bulb to 50,000 hours. About the size of the button on your coat, this solid-state device operates in series with the lamp, thus the filament burns cooler and lasts longer. The one hitch is that it reduces light output approximately 50 percent, requires doubling bulb wattage for full brilliance. Ideal for exit lights, yard lights, signs, hallways, and particularly where lights are hard to reach. Retails for \$1.20 from Terado Corp., 1068 Raymond Ave., St. Paul, Minn. 55108.

HINTS FROM READERS

Ink cartridge spreads glue

Fitted with a "paint-roller" handle, an empty fountain-pen ink cartridge makes a dandy glue spreader. The plastic cartridge is virtually self-cleaning since most adhesives can be easily peeled off when dry. Unlike a paint roller, the cartridge does not turn. It fits tightly on its wire handle and simply spreads the adhesive with a wiping action.—*Walter E. Burton*



Clothespin provides safe grip

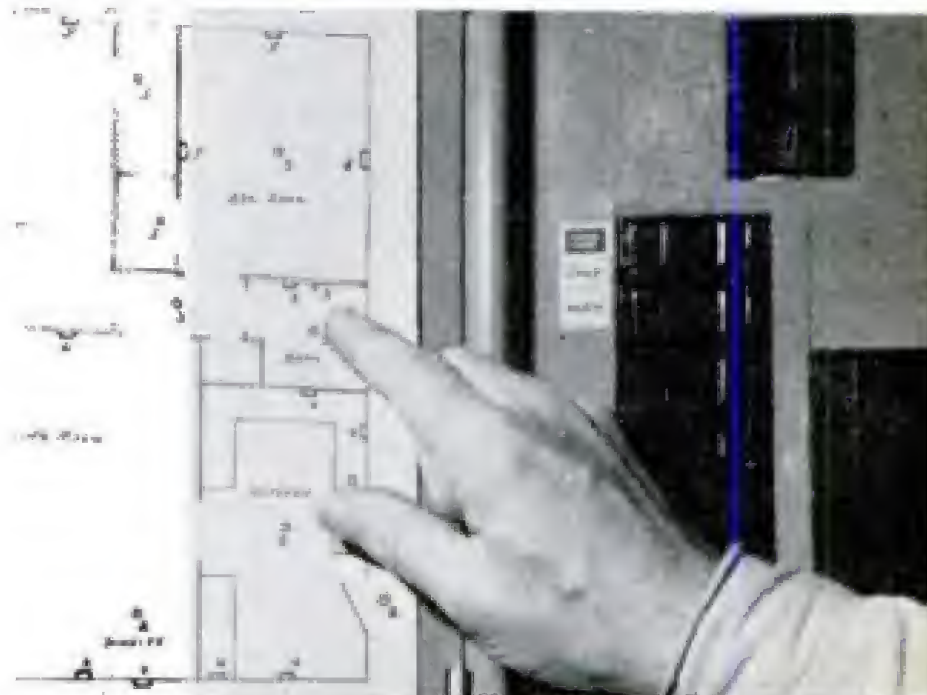
The problem of holding small-diameter tubing, plastic rod and other fragile work in a vise without damaging it is quickly solved with a spring-type clothespin. Cradled between the wooden jaws, the work is cushioned and protected and can be safely clamped in a regular vise. You should exert only a little pressure when tightening the vise.—*Victor H. Lamoy*



Outlet 'map' pinpoints circuit

I have found it a timesaver to have a numbered map posted near the circuit-breaker or fuse box which shows all the electrical outlets in the house. This way when a fuse blows, I can pinpoint it quickly, or if I want to kill a certain circuit to work on it, I know immediately what breaker controls it by its number.

To make such a map, draw a floor plan of each floor and spot the outlets and ceiling lights on it. Now trace through the lights on each circuit by killing them, one at a time, and noting which outlets each controls. Most fuse and breaker boxes have each circuit numbered and each outlet on the map is given a corresponding number. This way, for example, if you want to kill a bedroom outlet marked No. 3 on the map, you snap circuit switch No. 3.—*Herbert Y. Moon*



Benchtop sharpening pad

An abrasive-covered wood block fastened to the bench where it will not interfere with other work will be found extra handy for keeping a keen edge on a knifeblade or other cutting-edge tools. Pick a fine-grit abrasive, cloth or paper, and glue it to the block, then fasten the block to the benchtop with two small brads. Brush away all dirt before using.



How, When and Why You Should De-Thatch And Aerate Your Lawn

Take a tip from landscaping pros and remove the "blanket" that's smothering your lawn. You can do it yourself with rental equipment



DE-THATCHING THINS RUNNING STEM GRASSES	DE-THATCHING CUTS OUT LOW-GROWING WEEDS	TINY SLITS CATCH SEED, FERTILIZER WASHES INTO SOIL

AFTER ALL THE TIME and money you've invested in fertilizing, weed killing, and watering, does the appearance of your lawn still leave something to be desired? If so, is it possible your soil is not getting its share of air, water and nutrients, in spite of your conscientious efforts? Your lawn could be "starving" in the midst of plenty, due to thatch deposits on the ground, overcompacted soil or both.

Thatch is the accumulation of dead grass, leaves and other undecomposed organic matter. As this deposit grows it forms an almost impermeable, matlike layer that hinders penetration of air, water and fertilizer into the soil. Deep root development is thereby discouraged, and the lawn begins to thin out, paving the way for weed growth.

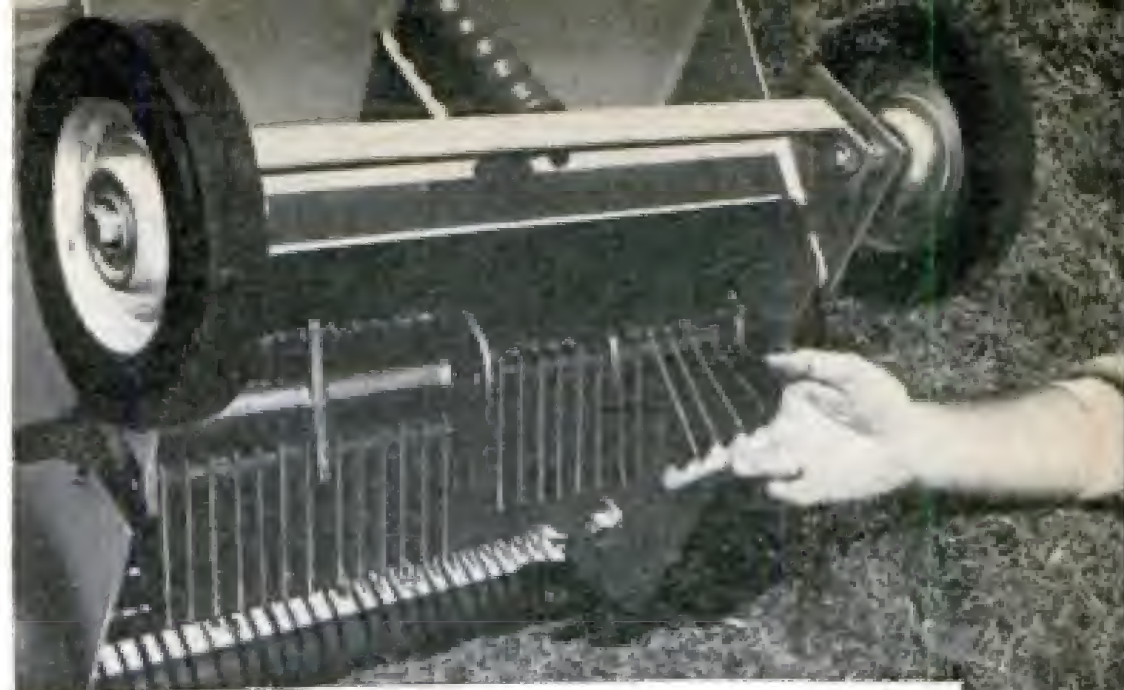
There are other reasons why thatch harms your lawn. According to Richard Delano, University of Illinois extension horticulturist, it can be an ideal breeding ground for lawn insects. Even worse, because many kinds of fungal spores can thrive in it, thatch encourages development of diseases such as striped smut, leaf spot and dollar spot in bluegrasses, and brown patch in bent grasses.

An overabundance of uncollected clippings is a major contributor to thatch formation. Soil acidity is another factor, since an alkaline soil condition is necessary for effective decomposition to take place. Some pesticides may also reduce the rate of decomposition, since in the process of eliminating undesirable insects they also destroy the microorganisms that carry out the decomposition process.

Another major reason for ineffective penetration of air, water and nutrients is excessive soil compaction, which closes off the network of pores and capillaries—the "breathing system" of the ground.

Compaction is likely to be most severe where there is a good deal of traffic; for example, where children play regularly. It's also caused when too many of Mother Nature's aerators—earthworms, ants and other insects—are killed by fertilizers and other chemicals applied to lawns.

Is your lawn in trouble? Try a quick experiment. Take a screwdriver with a 4-in. blade, and try to insert the blade completely into the ground. If you require some effort to push it in completely, chances are your lawn needs aerifying.



STANDARD DE-THATCHING ROTOR has 52 blades, individually removable for medium, light combing

Now, pull the blade out carefully so you won't dislodge any deposits, and examine it. (You might want to try this part of the experiment with a knife blade instead.) Do you see a peatlike layer above the soil deposit on the blade? If so, and if this layer is $\frac{1}{2}$ in. thick, or greater, you have a thatch problem as well.

Now that you know you have problems, what do you do about them? A vigorous hand raking in the spring and fall would help prevent thatch formation. However, once thatch is present the only effective way to deal with it is to remove it by mechanical means, just as the only complete answer to an overcompacted lawn is mechanical aeration.

Those masters of turf care, golf-course superintendents, are well acquainted with the benefits of de-thatching and aerifying, and follow these practices religiously on their greens.

"There has been very little done on aerifying of home lawns, yet this is a procedure that should be carried out regularly," states Paul N. Voykin, golf



THIS VERTICAL-CUTTING MOWER cuts out dead plant matter with eight oil-tempered, spring-steel blades



THIS DE-THATCHING MACHINE comes equipped with three interchangeable reels: tine, knife and flail, which are pictured in that order below the machine

course superintendent at the Briarwood Country Club in Deerfield, Ill. "One drawback is that the average homeowner is not acquainted with what aerifying does," he continues. "The other is that an aerifying machine is expensive, and will usually not be used more than once or twice a year. The same is true of de-thatching equipment."

However, Voykin notes that the current boom in rental equipment is right up the alley for homeowners who have only sporadic need for large, relatively costly machines.

"It's interesting to note that today homeowners have available to them, at modest cost, equipment that just five short years ago was used only by professional landscapers," observes Mason Warner, president of A to Z Rental, Inc., one of the nation's largest equipment-renting organizations with about 450 rental centers.

There are several varieties of de-thatching machines, all designed to pull out the thatch layer and deposit it on the surface of the lawn. Some remove more living grass in the process than others, and this may not be an important factor, depending on the type and condition of your lawn.

A de-thatching machine, sometimes called a vertical mower, consists basically of a reel having blades, tines or knives positioned around the circumference of the reel shaft. The machine is generally powered by a gasoline engine, and can normally cover 5000 square feet in about one hour. Following are some popular types of de-thatchers:

1. *Blade or flail type.* The reel on this version is equipped with from 30 to 60 hardened steel, rectangular blades, each about $\frac{1}{8}$ x 1 x 4 in. in size. In some cases, one end of the blade may be sharpened to a point. Depending on the manufacturer, the blades may be free-swinging, or rigidly attached to the rotor. As the reel turns, the thin, high-speed blades pass vertically through the living grass, cutting through and lifting out the thatch below. In the process, the blades cut narrow slits in the soil, making an ideal bed in which tiny roots of newly germinated seed can flourish. This type machine is also useful for renovating poor lawns that are to be reseeded, and can break up clods after tilling in preparation of seed beds.

A flail-type reel is well suited for use

on bluegrass lawns in northern and some middle sectors of the United States. One version permits removal of some blades in order to achieve optimum thinning and slicing action needed on southern, bent-type lawns.

2. *Tine type.* The reel on this machine uses thin, wire-like, flexible tines in place of flails. Typically, about 100 tines are employed. This unit provides a combing-type action, and minimizes removal of living grass. It is particularly designed for use on established bluegrass lawns.

3. *Knife type.* This reel uses anywhere from 25 to 50 knife-like elements which depopulate plant growth by removing some living grass as well as loose thatch. This unit is particularly effective on Bermuda, zoysia, St. Augustine and centipede grasses, more commonly found in the southern sector of the United States. It is also useful for controlling growth of weeds such as wild fescue, crabgrass and nimblewill.

Tests have shown that up to 20 to 30 bushels of thatch may be obtained from just 1000 square feet of lawn. The resultant debris must now be removed from the surface of the lawn, and the most effective way is with a power sweeper, which is also available at rental centers. The sweepers generally operate by vacuum or with brushes. The debris can then be transferred to plastic bags for disposal.

If you have a garden and can afford the space, you might consider using at least part of the recovered thatch, which is largely grass clippings, to form a compost pile. Mix in some black soil, and you will duplicate the compost-making activities of the earthworm, who does his work by bringing black soil up over dead grass.

Like de-thatching machines, aeration equipment utilizes a reel equipped with a number of elements positioned around the rotor shaft, powered by a gasoline engine. In principle, an aerating machine removes small plugs of soil from the ground, thereby alleviating compaction and opening up pore spaces for penetration of air,

water and fertilizer. The action encourages development of deep, drought-resistant root systems.

One type of aerating machine utilizes hollow tines that penetrate about 2½ in. into the ground on 5-in. centers. In operation, a plug of soil is forced into the central core of the tine, which on the next revolution is forced out by a new, incoming plug.

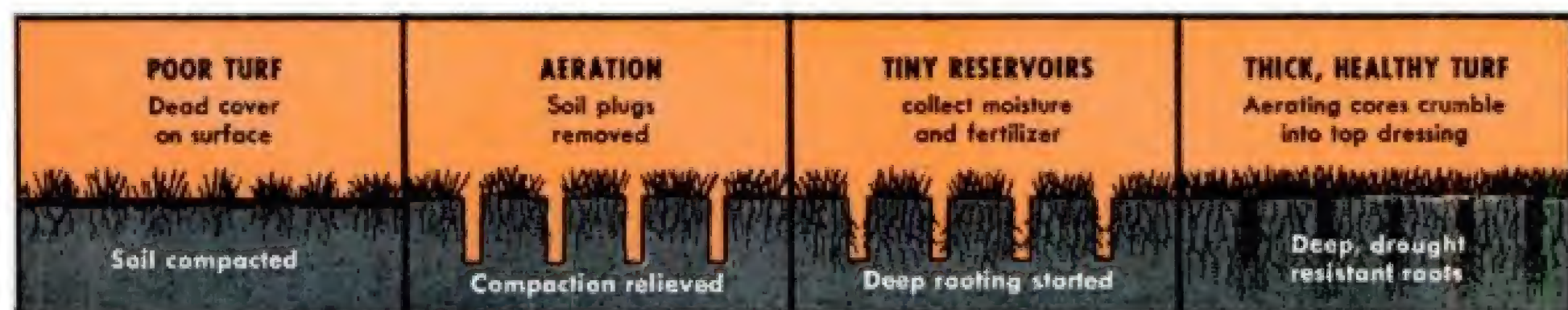
Another type employs an open, half-round "spoon" that scoops out a core of soil to give surrounding earth room to expand. The action provides a loosening effect without disturbing grass.

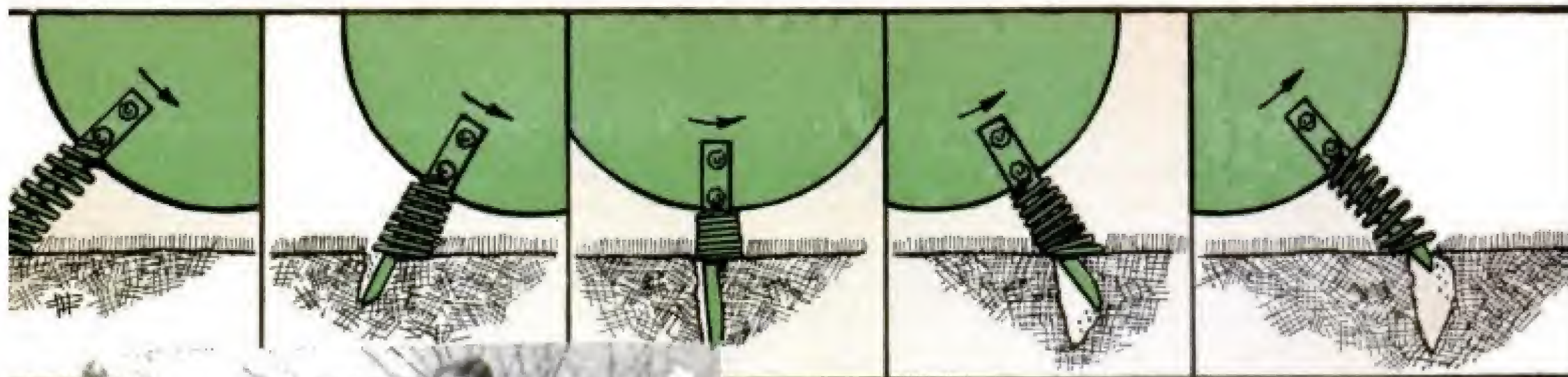
The soil cores that have been deposited on the surface of the ground can be removed by sweeping, but it would be more beneficial to the lawn to leave them and let the soil work its way back in.

A distinction should be made at this point between aerating machines and equipment having solid tines or spikes. The latter type does not aerate, but actually increases compaction. Unlike aerifying, it does not remove any soil cores. It is sometimes used in the hot, dry months,



AERIFYING MACHINE penetrates up to 2½ in. on 5-in. centers, to cut out soil plugs like those above





THIS AERIFYING MACHINE has "spoons" that scoop out cores of soil in manner shown in diagram above

in order to open the surface crust of soil, thus permitting water penetration and preventing runoff.

Although there are differences of opinion among authorities, it's generally agreed that spring and fall, when grass grows most vigorously, are the best times for de-thatching and aerifying.

After thinning-out of dead matter by de-thatching, it is desirable to stimulate a fresh, strong growth of grass so as to prevent further thinning out. Likewise, vigorous grass growth is important after aerifying, so that deep-rooted grass fills up the holes that have been left in the ground.

Of the two seasons, fall is probably slightly preferable for aerifying, since some natural aeration takes place in spring through freezing and thawing action. On the other hand, the most vigorous growth occurs in spring, so this may be the best time to de-thatch. Many authorities recommend performing de-thatching and aerifying at different times,

since their combined action could have a shock effect on the turf.

Generally, it is recommended that each be done once a year. A good maintenance program, then, might be de-thatching in the spring and aerifying in the fall.

One note of caution is in order for aerifying in fall. Preferably, this should be done before mid-October; if aerifying is done too late in the year, there is a possibility that some holes will remain open all the winter. Then, if there is little snow and a general lack of moisture, wind action can have a damaging drying effect on the lawn.

These generalizations will have to be modified to fit individual situations, and the homeowner will have to exercise his own judgment. Some grasses decompose more slowly than others, thereby providing more of a thatch problem. This is particularly true of such grasses as Bermuda and zoysia, which are fibrous in nature and resistant to decay. With such lawns, more frequent de-thatching may be desirable. Again, in parts of Florida and the southwest, where the soil is quite sandy, compaction is not much of a problem, and very little aeration is necessary.

Thorough watering to stimulate growth is desirable after both de-thatching and aerifying. These are also excellent times for applying fertilizer and reseeding, if needed.

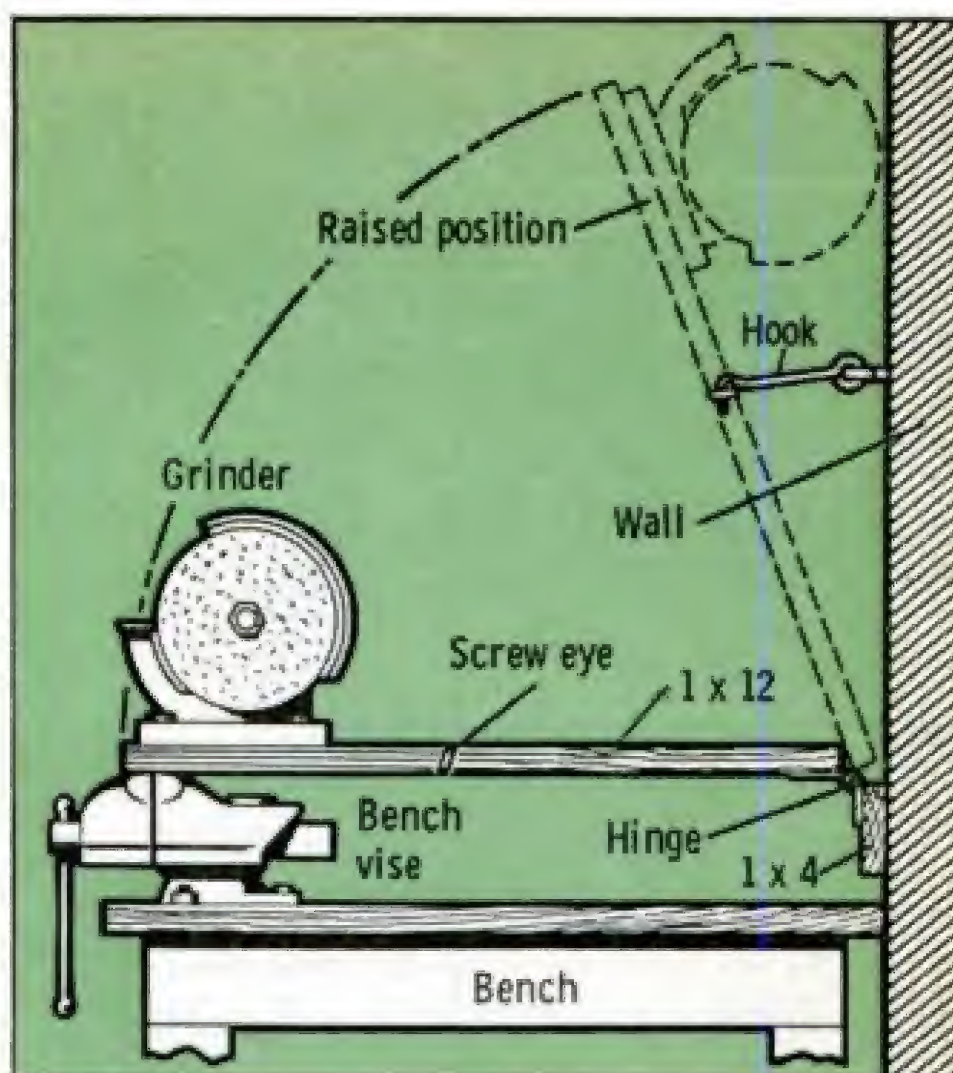
A good way to minimize thatch accumulation is by adopting consistent mowing habits. This is especially important in spring, when a few days' procrastination during a lush growth period will result in an overabundance of clippings when mowing is finally performed. At such times, even a good grass catcher will not be effective enough.

When starting a new lawn, use 4 to 6 in. of black topsoil and mix in plenty of sand to minimize compaction problems that may occur later on. ★★★

HINTS FROM READERS

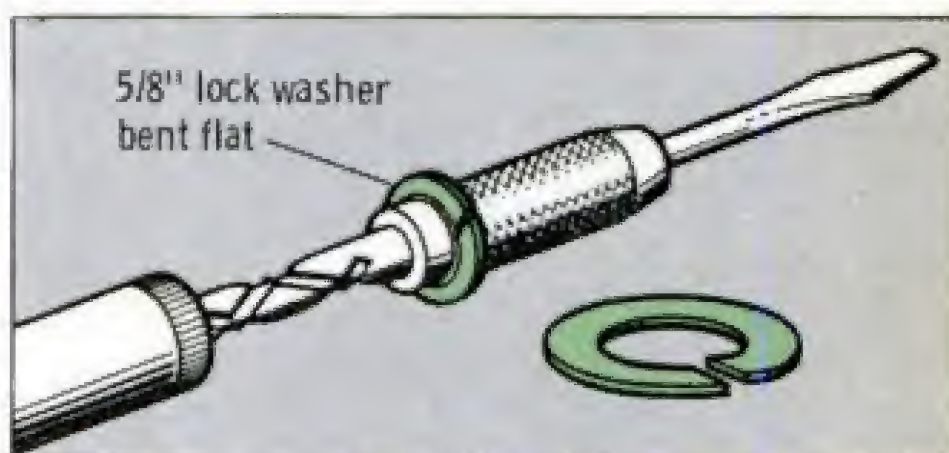
Grinder mount saves space

If a machinist's vise is already taking up valuable workbench space, you can hardly afford to have a grinder permanently bolted to it also. Since a grinder is used far less frequently than a vise, here's a way you can mount it to swing up out of the way when not in use. Bolt it to a 1x12 board and hinge it to a 1x4 block screwed to the wall. Mount the block at a height to bring the grinder level with the top of the vise. A 3 or 4-in. vise will hold the grinder at a nice working height. A couple of sturdy hooks and eyes will stow the grinder against the wall.—*B. F. McNamee*



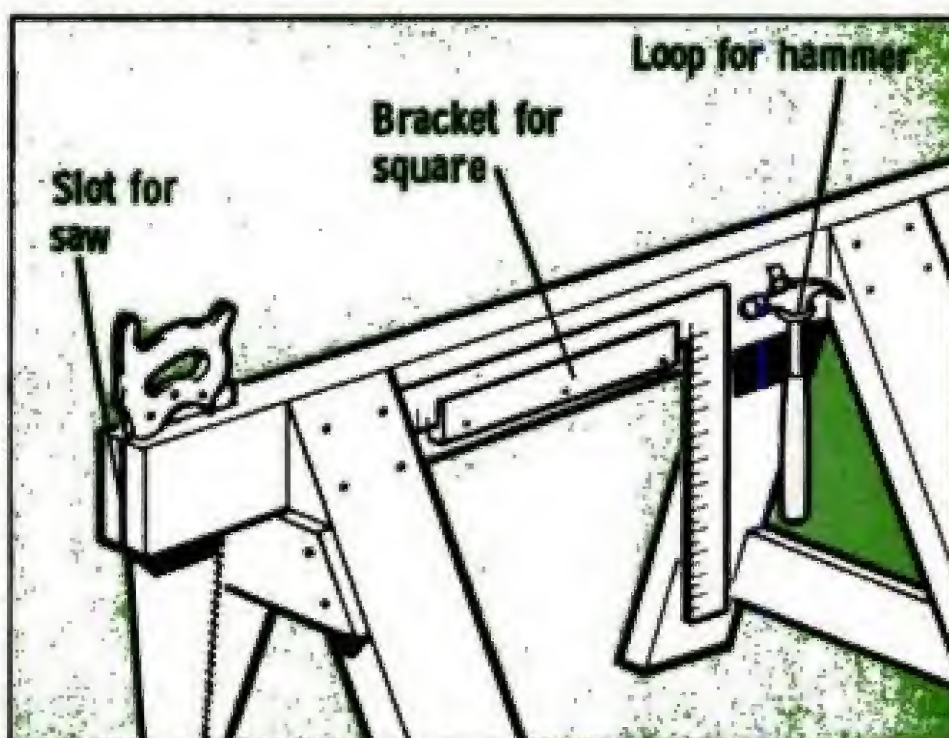
No more pinched fingers

Sooner or later you're going to pinch your fingers when using a spiral ratchet screwdriver. You can avoid this happening by placing a collar over the chuck as shown. A split lock washer, annealed, flattened, spread apart and forced over the knurled grip, will do the trick nicely. To anneal the washer, heat it to a dull red, then let it cool slowly.—*H. Josephs*



Making sawhorse handier

There are three things you can do to make a wooden sawhorse handier when it comes to keeping track of your tools. Cut a slot in one end for the saw, tack a piece of flooring (groove side up) to hold a framing square and attach a loop for your hammer. You'll know right where these tools are when you're looking for them.



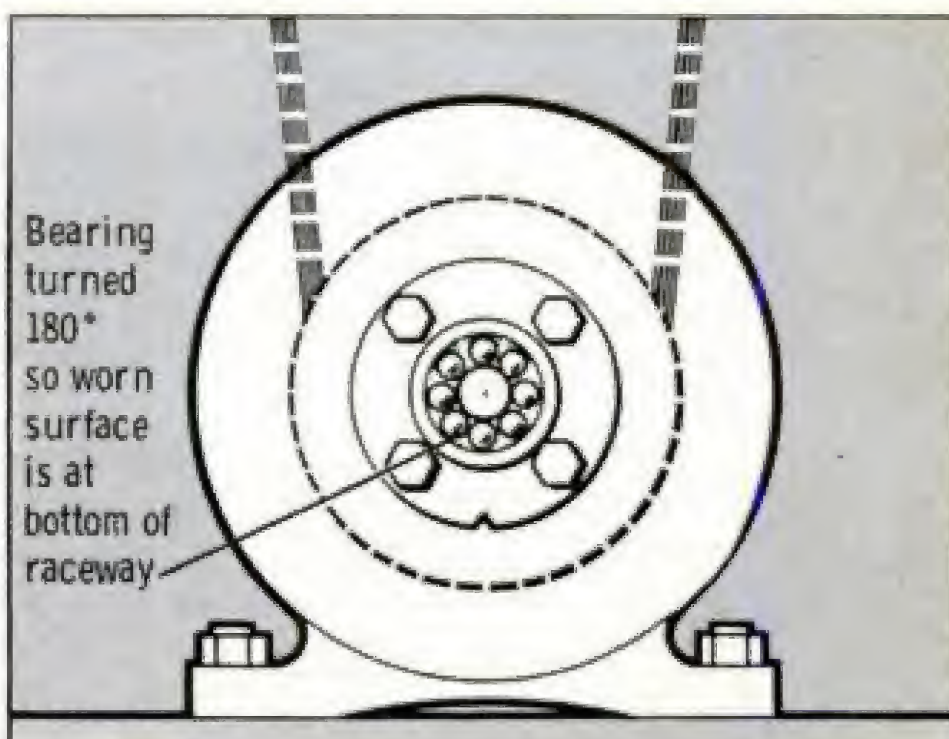
A backward idea that works

When cutting corrugated aluminum roofing, I have found that the regular skip-tooth blade of an electric saw will cut across the "hills and valleys" much faster if the blade is put on backward. Makes a smoother cut, too.—*Keith N. House*

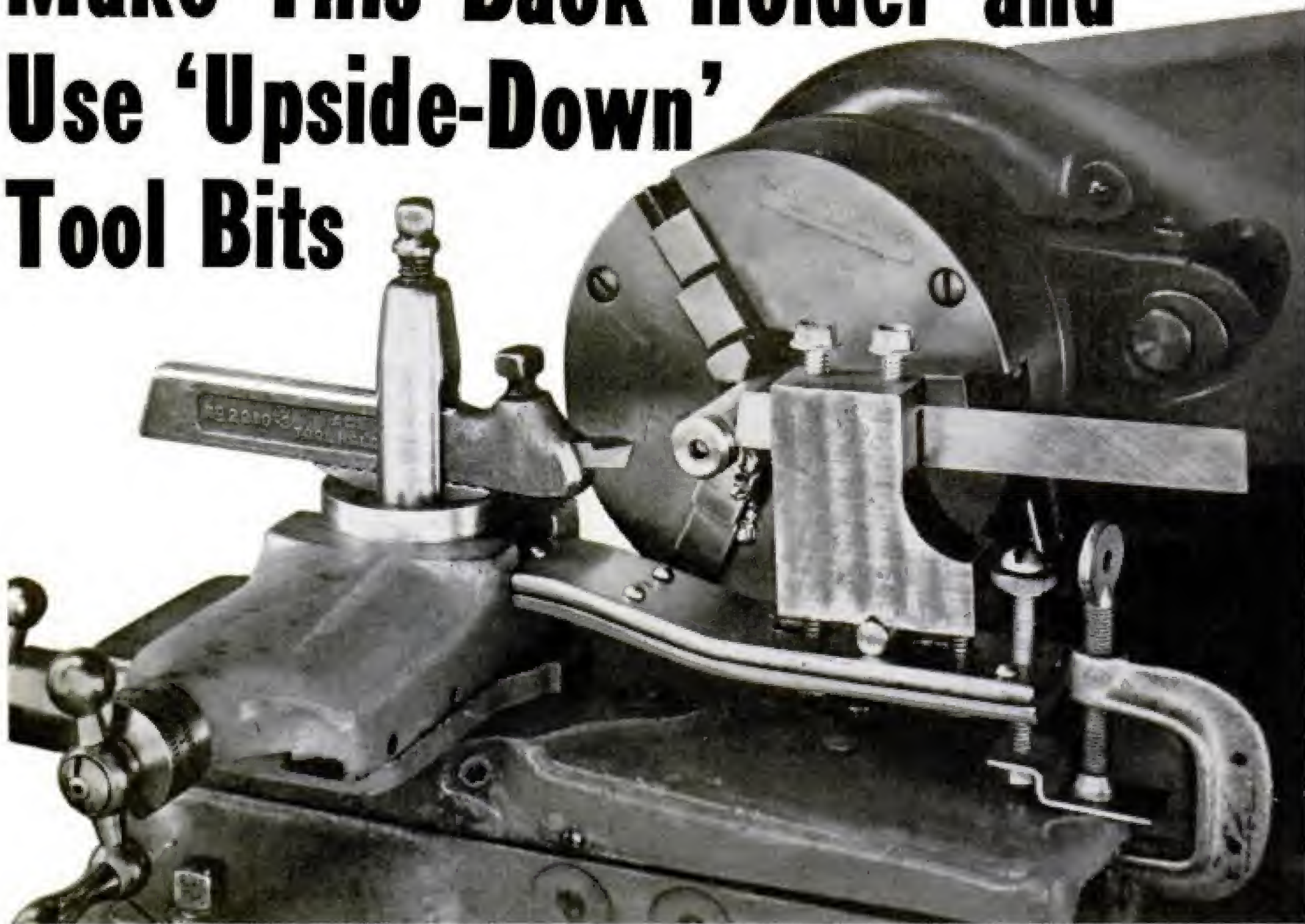
Silencing noisy bearing

The bearing next to the pulley on our lathe motor started to run noisily. Suspecting that constant belt tension had caused the outer raceway of the bearing to wear, I rotated the bearing housing 180°. This brought a new surface to the top to resist belt pull. It stopped the noise.

—*Emil Wittman*



Make This Back Holder and Use 'Upside-Down' Tool Bits



SETUP FOR CUTTING A RING from round stock with inverted parting tool mounted at rear of the cross slide

By borrowing an idea from turret lathes you can speed up and improve many operations on a metalworking lathe

By **WALTER E. BURTON**

THIS BACKWARD IDEA is the reverse of normal lathe technique—you invert the tool bit and mount it behind the workpiece. Such a “back” position has been found to be particularly effective for cutoff (parting) tools. By using a back toolholder in conjunction with a conventional front one, the number of cutting bits immediately available for an operation can be doubled or better, and work is correspondingly speeded. You may find an inverted tool often cuts more smoothly than the same tool right-side-up.

There are numerous ways of providing a backholder for upside-down tool bits. (Practically all tools have to be inverted when fed from the back so they will function as the workpiece is revolving forward in the usual manner.)

For some lathes, special cross slides

Technical Art by Associated Technical Services, Inc.

having slots for mounting toolholders in both front and rear of the workpiece may be obtainable. The lathe owner should not find it difficult to work out a way of adding a rear toolpost to his particular machine when such a cross slide or attachment is not available. Such a unit can be designed to operate on the cross slide after the compound has been removed; or the compound can be left in place and used as a support—as was done for the attachments described here.

The illustrations show two systems (one on a 9-in. bench lathe, the other on a Unimat) which do not require any modification of the lathe itself. The attachments can be installed or removed in a minute or so, and thus rank with conventional toolholders for convenience. On the 9-in. lathe, the compound, on which the front

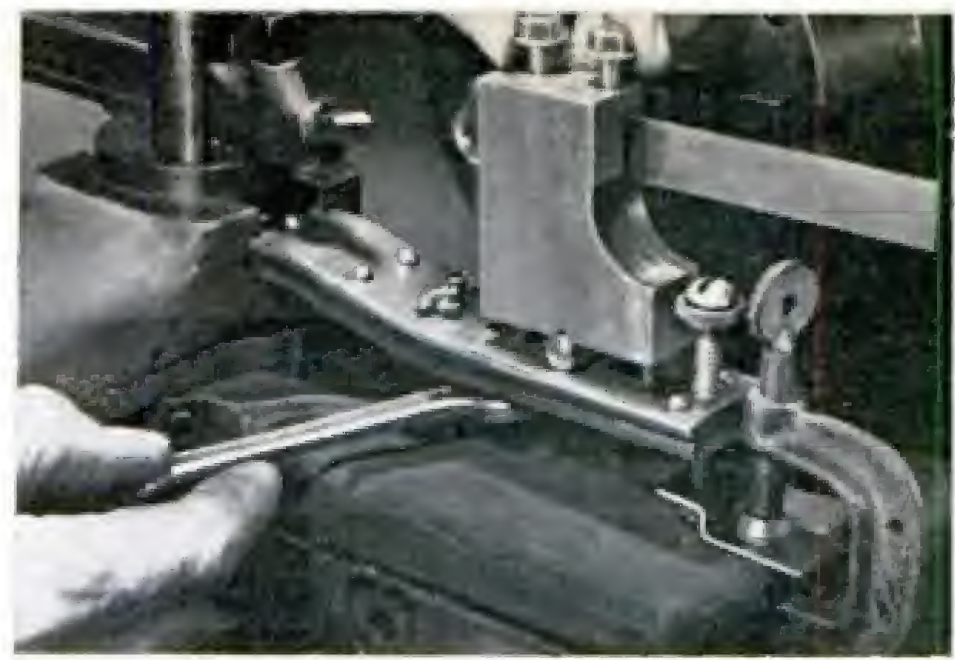


TWO SETSCREWS lock attachment to toolpost slot so it can't shift when post is loosened for adjustment

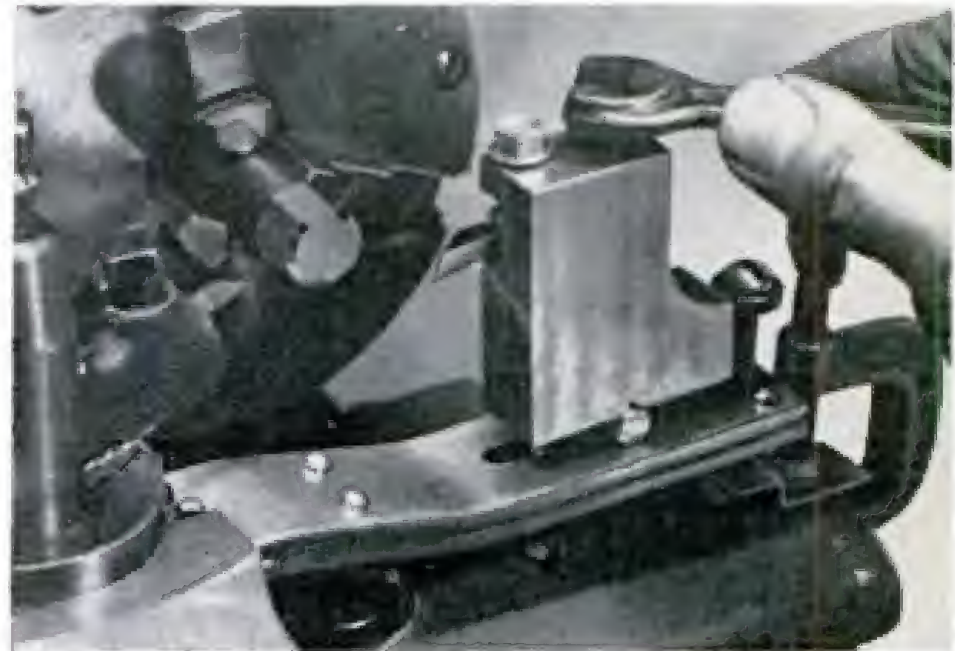
end of the attachment is anchored, is swung parallel to the lathe bed and is not moved during machining operations.

In any kind of back-tool support, it is important that there be a high degree of rigidity to reduce chatter and any tendency of the tool to climb on the work. The front end of the base piece of each attachment is secured in the regular toolpost slot of the carriage, and the back end is restrained by a clamping arrangement. It is possible to use the units without anchoring the "loose" ends, but tool-climbing, vibration and chatter can be expected to be greater.

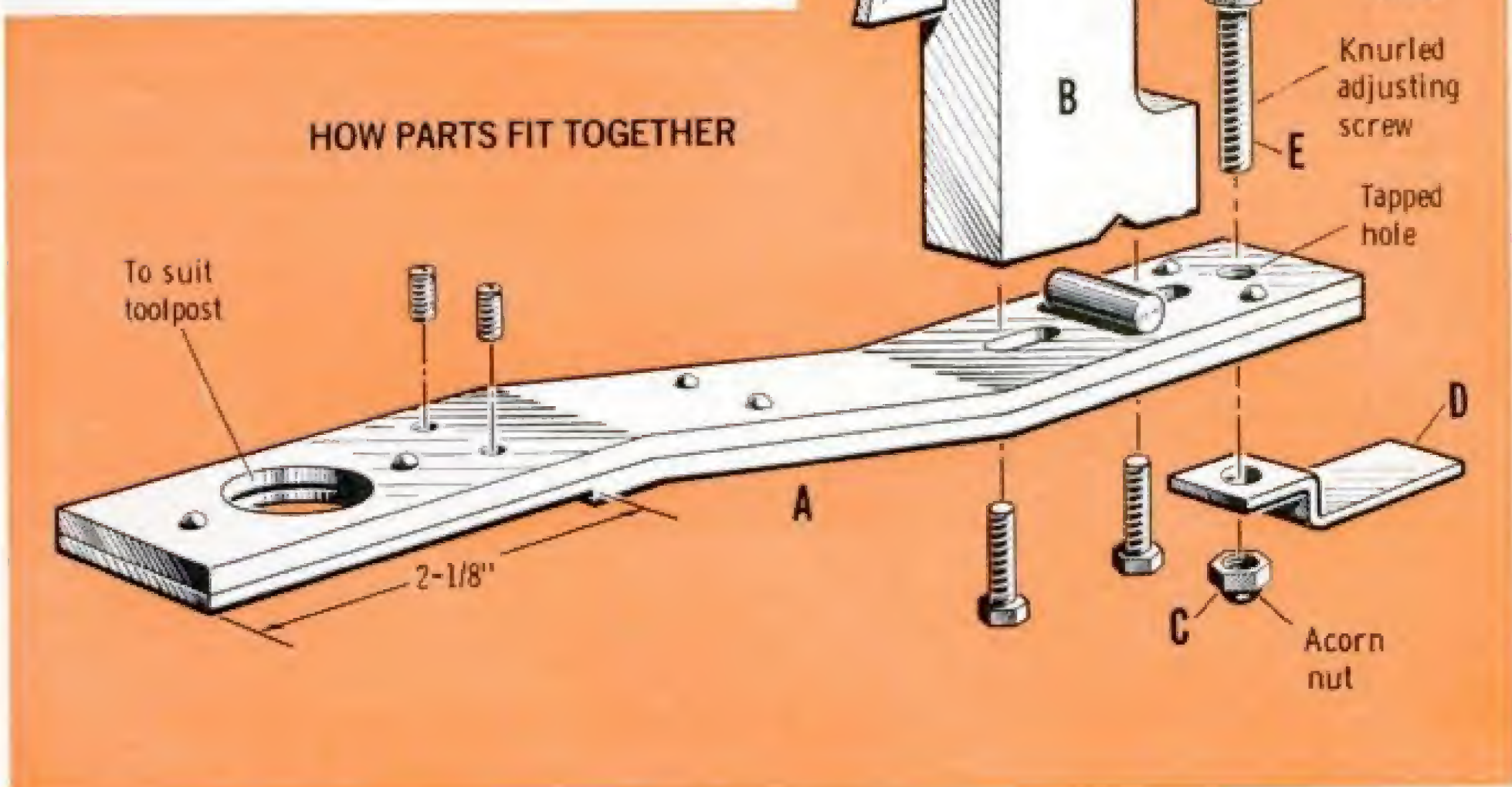
So, for the base piece of an upside-down toolholder, the stock should be as thick and rigid as feasible. In the drawings, piece A is the base for the 9-in. lathe attachment. It was bent to position the back toolholder somewhat below the level of the toolpost slot in the compound

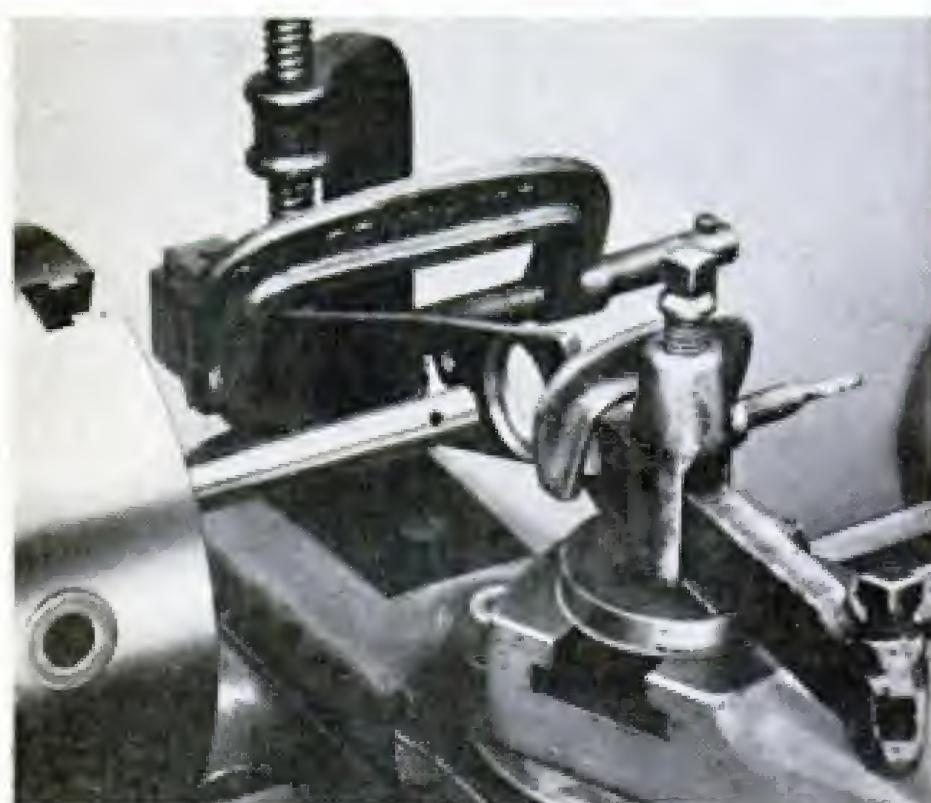
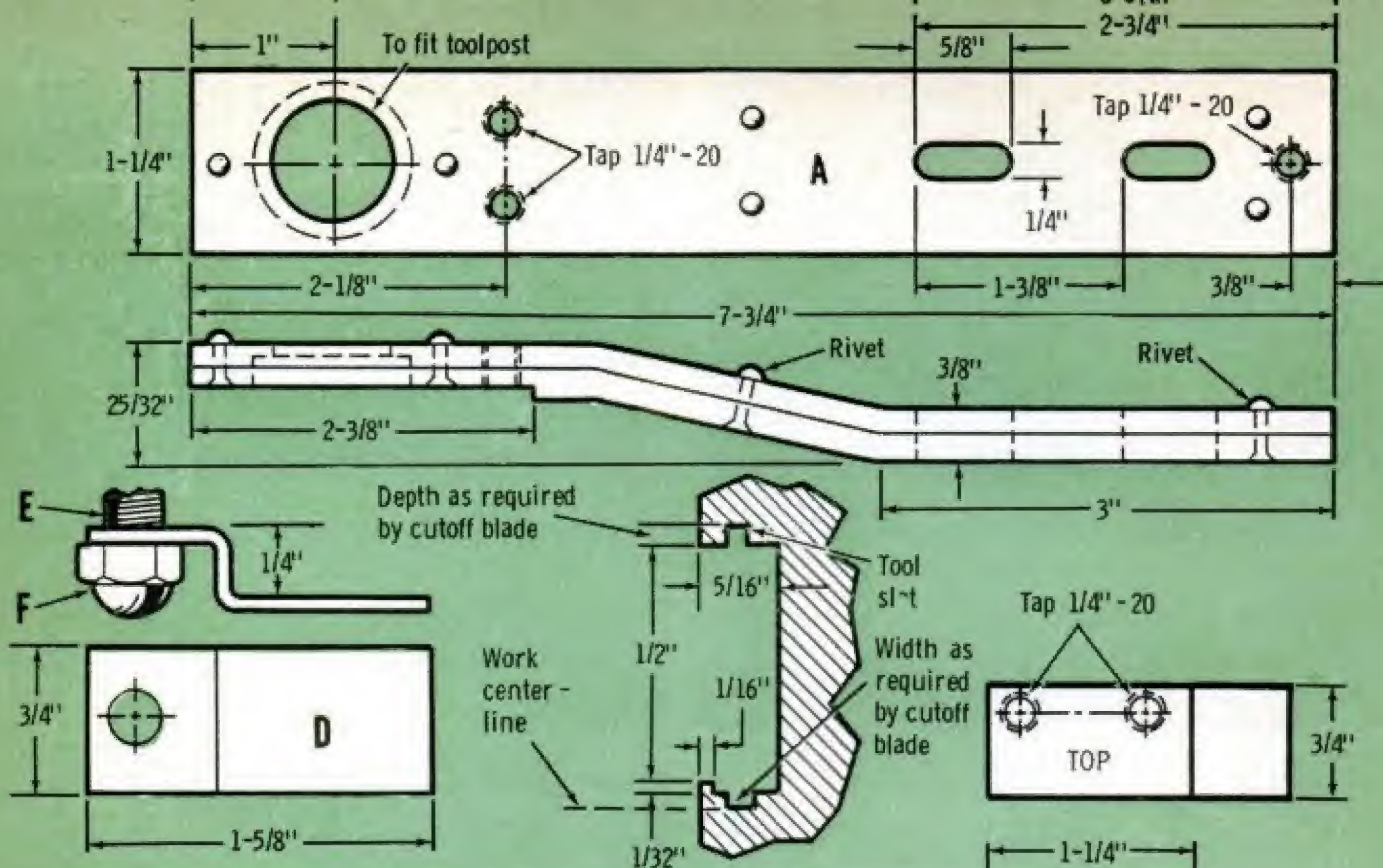


FINE ADJUSTMENT of toolpoint position is had by turning two bolts that clamp block B over fulcrum pin

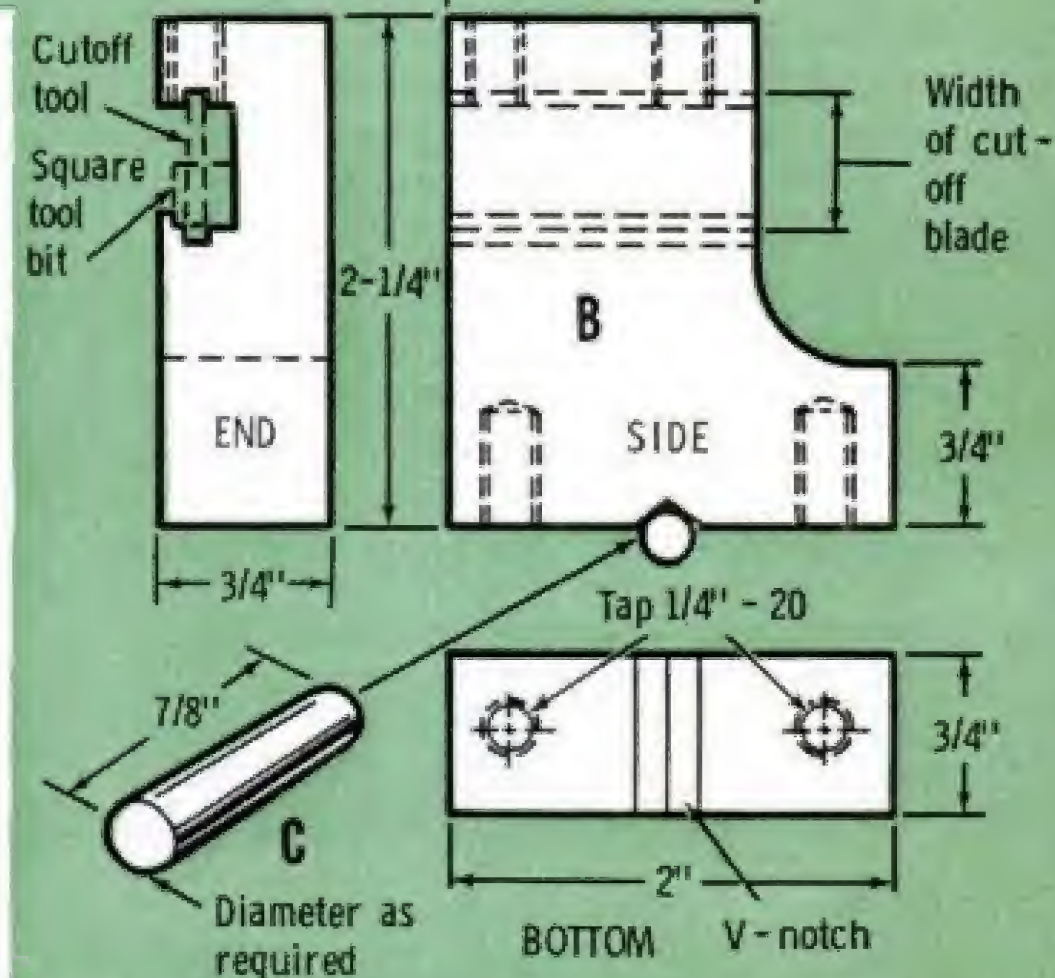


REAR TOOLHOLDER will accommodate conventional square bits also. Two bolts lock the bits securely

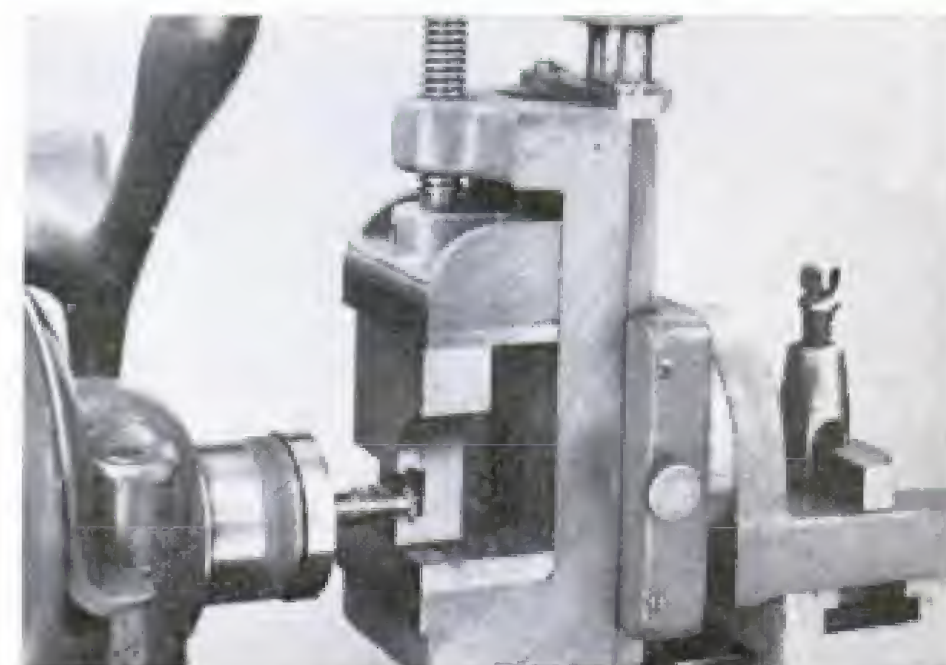




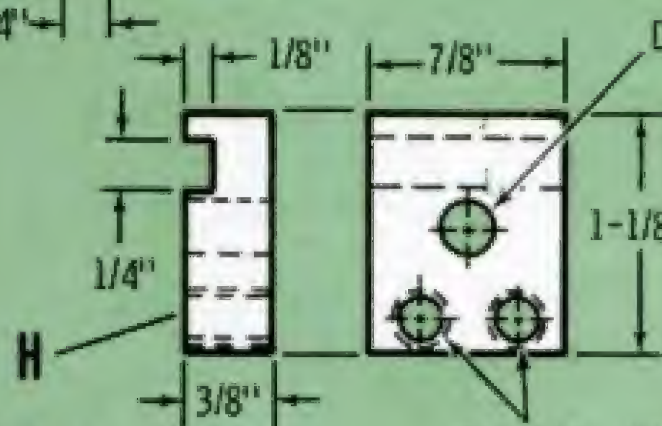
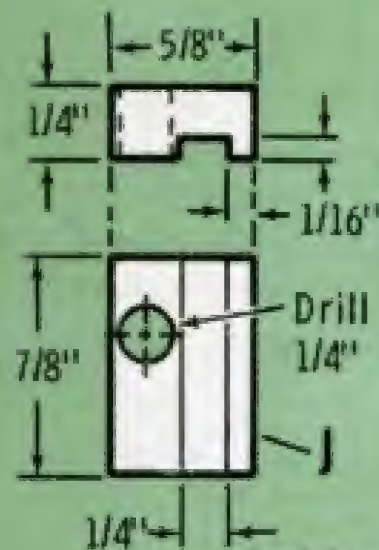
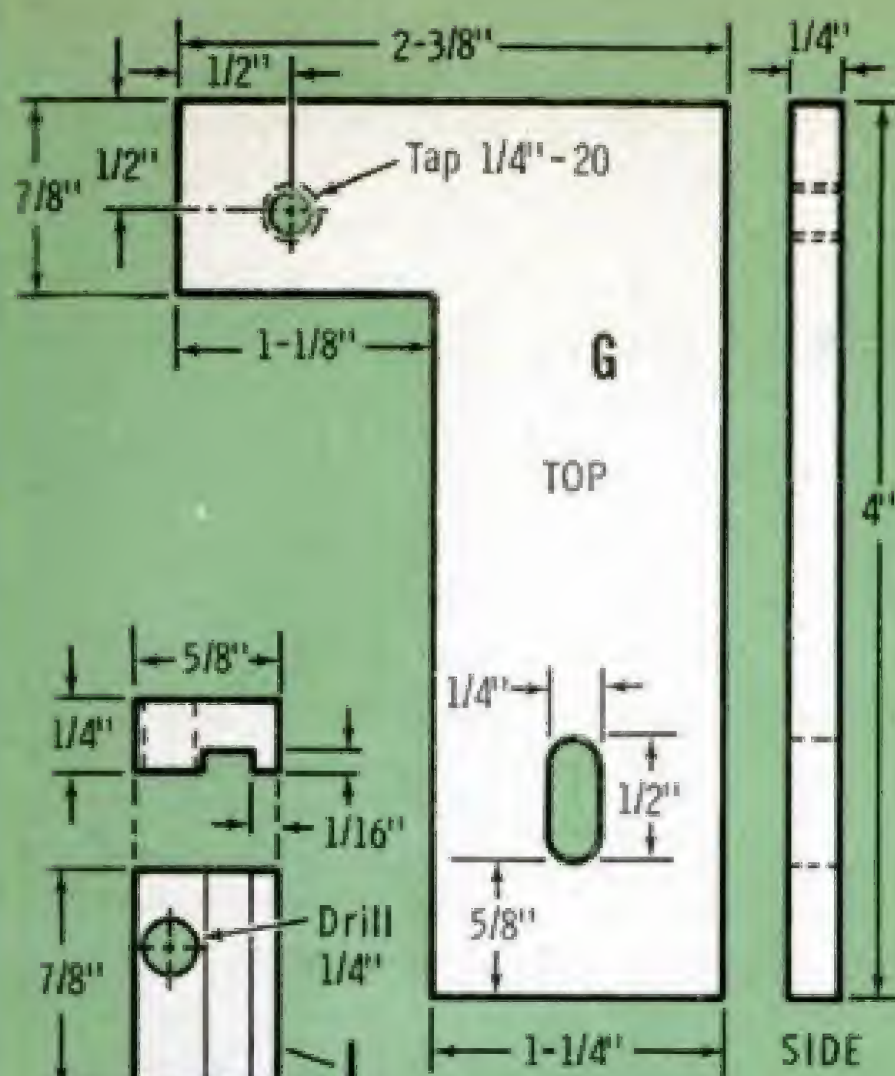
TO FINISH-BORE TOOLPOST HOLE in bar, work is clamped to regular toolpost holder and to a steel block clamped to rear end of cross slide with C-clamps



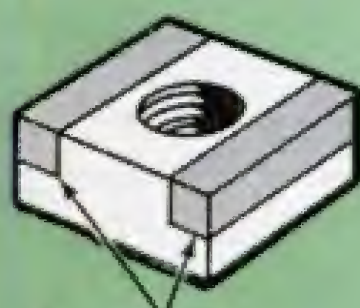
TOOL SLOT IN BLOCK is roughed out on a milling machine with two saws, then center web is removed



SLOTS FOR CUTOFF BLADE in bottom of main groove are made with keyway cutter similar to a Woodruff

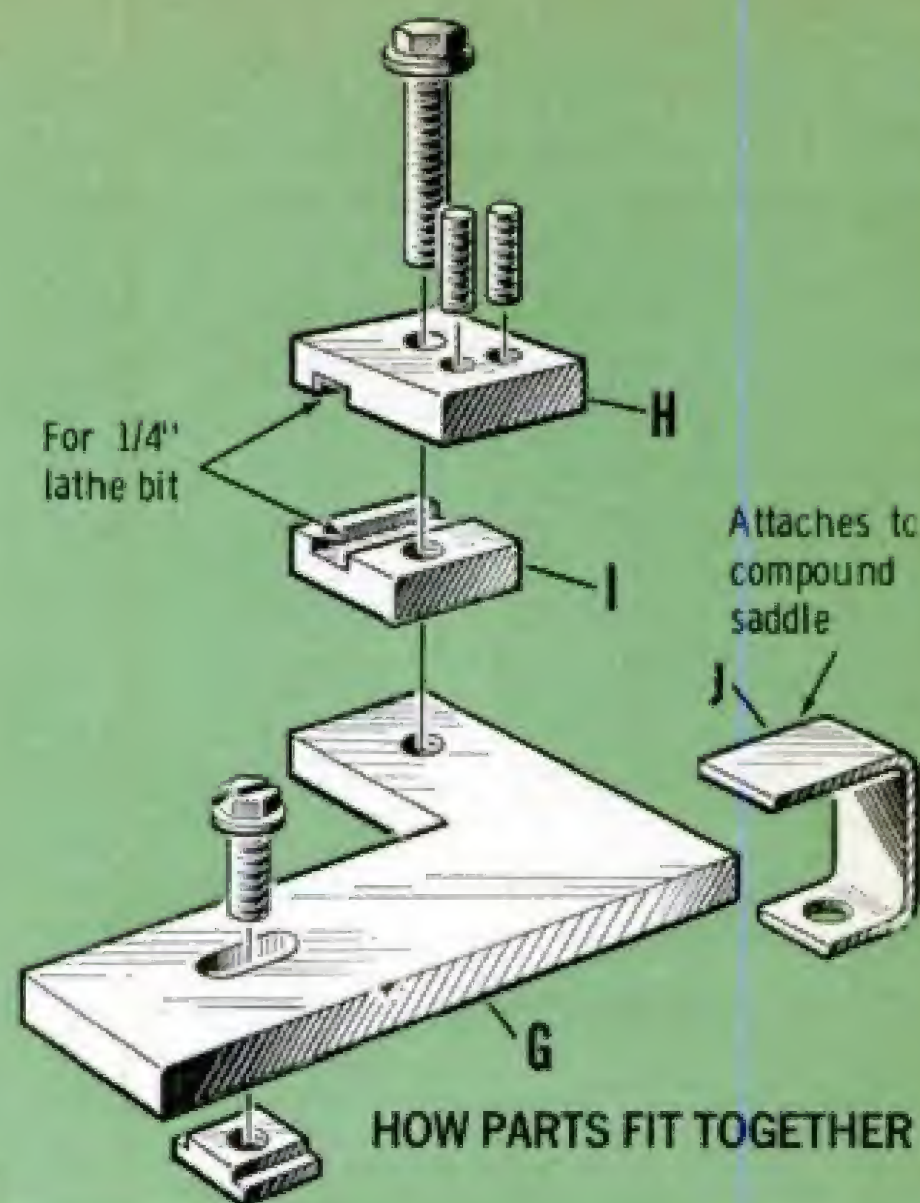
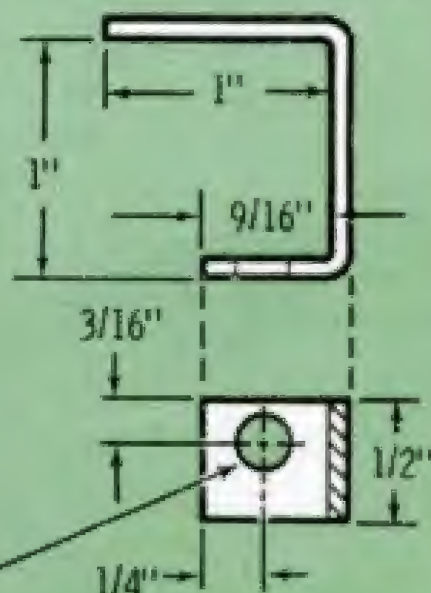


T-nut made from common square nut

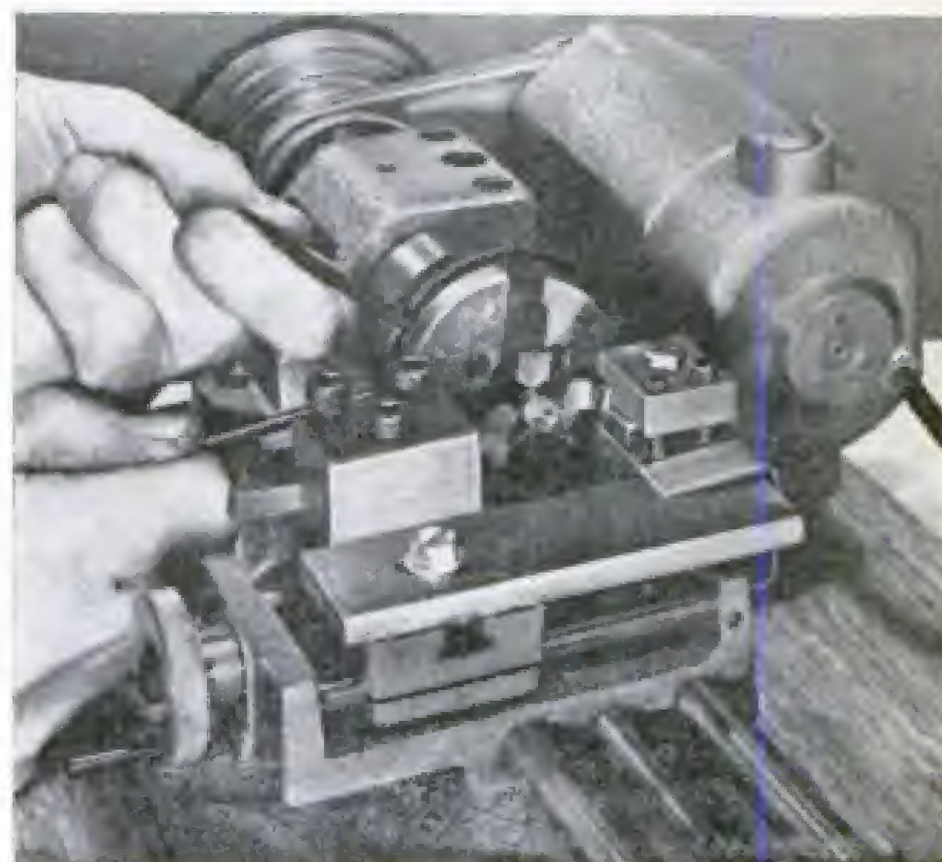


Cut away shaded portions

Size to accommodate carriage lock bolt



HOW PARTS FIT TOGETHER



SECOND ATTACHMENT, designed for Unimat lathe, uses square bit for both cutoff and facing operations

slide. This creates more space under the lathe spindle. However, the piece could have been straight without coming too close to chuck jaws for most small-diameter work. When I was making the attachment, there was a typical small-shop problem: No bar stock of sufficient thickness was at hand, so piece A was made by riveting together two thicknesses of 3/16-in. steel bar.

Piece A is locked in the slot on the compound slide by the regular toolpost, which passes through a hole near the front end. Near this hole, two 1/4-20 set-screws were installed to bear against the

slot bottom, so the attachment will not shift when the toolpost screw is loosened for adjustment—especially during setup. The portion of the bar that enters the toolpost slot must, of course, be machined to width and thickness for a snug fit.

The rear toolholding block, part B, must be adjustable for tool height, so the tool tip can be aligned properly with the work. The seesaw arrangement permits both rough and fine adjustment with ease. The block rests on a steel pin under a central V-notch in the bottom, and is secured by two bolts extending upward through slots in piece A. By selecting a pin of proper

diameter, the tool tip is positioned approximately level with the workpiece centerline. Then, by loosening one bolt and tightening the other, the block is tilted forward or backward for almost micrometer adjustment. To obtain enough clearance with some chucks, it may be desirable to set the block farther back on piece A than the drawings indicate, and to use a steadying bolt E that does not extend upward enough to interfere with the block.

The horizontal slot in block B was designed to hold either a standard $\frac{3}{32} \times \frac{5}{8}$ -in. high-speed-steel cutoff bit or a conventional $\frac{1}{4} \times \frac{1}{4}$ -in. tool bit. Bits are locked in place by two $\frac{1}{4}$ -20 hold-down bolts. A shim can be used under the bolt ends if the bolts are not long enough for the smaller bits.

No matter how massive base A is made, it probably will tend to spring and vibrate (when cutter is being used) if its tail end is not anchored. One way of anchoring would be with a bolt engaging a threaded hole in the cross-slide top; but largely to avoid marring the slide, the lower end of the bolt was provided with a bracket, D, which is anchored with a small C-clamp positioned so as not to interfere with cross-feed operation. It was found desirable to use a locknut (not shown) on the bolt, jamming it against the bottom of piece A. Nut F on the bolt tip is

a roundhead type, turned tight. Bracket D is shaped to exert downward pressure on the nut when the clamp is tightened.

Movement of tools in the back holder and conventional front toolpost is controlled by cross-feed and carriage screws.

An attachment for using inverted back tools on a Unimat lathe is shown in drawings G to J. The base piece, G, was made from $\frac{1}{4}$ -in. steel plate. A $\frac{1}{4}$ -20 bolt engaging a T-nut in the toolpost slot fastens the plate to the carriage, alongside the regular toolpost. Two grooved steel blocks, H and I, are used to mount a $\frac{1}{4}$ -in.-square tool bit on the plate.

The square groove in I is cut so it normally will lower the tool point somewhat below the workpiece centerline, and a shim directly under the bit or block I elevates the point to the proper level. Then if, in resharpening, the bit is ground so the point shifts upward, the shim can be changed or removed to bring the tool tip back into alignment.

Two $\frac{1}{4}$ -in. setscrews in H are used as a fulcrum to apply locking pressure on the bit by tightening the $\frac{1}{4}$ -20 hold-down bolt. The bit can be swung at various angles around the bolt, for aligning the cutting edge in forming bevels.

The tail end of plate G is steadied by bracket J, fastened to the lathe carriage by the regular carriage-locking bolt. The

[*\(Please turn to page 193\)*](#)

NEXT MONTH IN SHOP AND CRAFTS

WHAT'S NEW FOR POLISHING AND BUFFING. Traditionally, the polishing of metal has been done solely with cloth buffing wheels. Now most production polishing is done with coated abrasive belts, first with a dry belt, then with a belt lubricated with grease. Read how you can practice this new technique in *PM* next month.

HOW TO INSTALL GUTTERS AND DOWNSPOUTS. If the roof on your house is sky high, you'd do best to leave a new gutter job to the pros. It's not worth risking your neck. However, if it's only one-story high, you can easily take on the job yourself and save money. Aluminum and vinyl gutters go together like the parts of an Erector set, without tricky soldering. If your gutters need replacing, be sure to read this timely home repair story in the September *PM*.

THOSE TOUGH-TO-PICK LOCKS. How pickproof are the locks on the doors of your house? If they're a common pin-and-tumbler type without a dead bolt, any petty thief would find it easy pickings to walk in at will. Such locks are common because of price. For your own sense of security check the locks on your doors, then pick up the September issue to see what's new in pick resistant locks.

BUILD YOUR OWN FENCE WITH PRIVACY PANELS. Packaged fence "boards" of pressed aluminum are the latest things to use in building a smart custom-made fence for your yard. Available in white and redwood, and in three different lengths, they're applied to a framework of wood or pipe in a pattern of your own design. Read about this new idea in fence building in the September issue.

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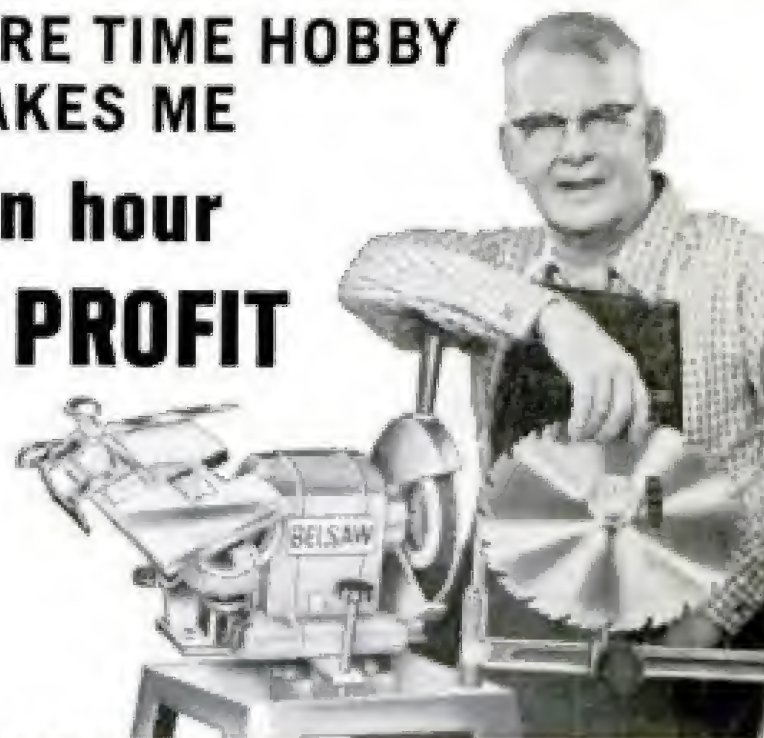
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HOW THEY KEEP YOU SAFE

(Continued from page 81)

tor examining your chest with a fluoroscope, each reveals the innermost region of a structure without actually touching or affecting it.

NDT has grown in importance with the complexity of our civilization. In the early days of railroading, it was sufficient to test new wheels by hitting them with a sledgehammer. A clear, bell-like tone indicated that a wheel was free from cracks or other defects. Suddenly, one foundry began getting 100 percent rejects—all of the wheels sounded dull. When the remakes also testified faulty, someone thought to check the sledgehammer—it was cracked.

Today, life is too complex and fast-paced for such quaint measures. We are constantly surrounded by scores of man-made hazards. Every time you step into an airplane or come near a high-pressure steam boiler, you are in the presence of a

X-raying solid-fuel rocket propellants assures there are no air pockets . . .

potential bomb as deadly as any military type. Boiler explosions were once a common occurrence. In Mark Twain's days on the Mississippi, one steamboat a day, on the average, blew up.

Gas mains under city streets need constant examination. Once a break starts, a gas pipe can split open faster than the speed of sound, causing tremendous devastation for thousands of feet along its length. In mid-January, 1967, such an explosion ripped through four blocks in Jamaica, N.Y., demolishing many houses. Early this year, another gas-main blast caved in a street in lower Manhattan.

Similarly, a defect as small as a burr on a rivet can produce a lethal effect in an airplane. It's estimated that a plane flying at 35,000 feet and pressurized to 10,000 feet stores about as much blast energy as a 200-pound high-explosive bomb. One tiny leak in the fuselage and the plane would burst apart like a balloon stuck with a pin.

Only modern NDT methods can prevent accidents like these. Philip D. Johnson, managing director of the American Society for Nondestructive Testing, says that the NDT market, pegged at \$125 million annually, is expected to as much as double within five years. The technique achieves savings in the neighborhood of millions

of dollars a week and employs some 500,000 people. The American Navy was the first organization to recognize that this technology could be trusted to test the safety of welded steam vessels.

NDT is now indispensable in virtually every area of American life—industrial, scientific, medical and consumer. It's essential because all materials have defects. The traditional system of spot-checking items rolling off an assembly line tells only that an occasional sample is all right. It reveals nothing about all the others. With NDT, every single item can be checked—an important point in an age when it would be catastrophic to test one out of every 10 wing spars and assume that the other nine were okay.

The most frequently used NDT technique is radiographic inspection. X-rays or gamma rays are used to make internal pictures of objects either on permanent film or on a fluoroscope screen. Defects show up as dark areas just as a bone fracture does on a doctor's X-ray.

One of the most powerful radioisotope units is the Picker Corp.'s "Cyclops." Using a pill of radioactive cobalt-60 less than half an inch in diameter, it can X-ray 6-inch-thick steel in six minutes. X-raying solid-fuel rocket propellants assures that there are no air pockets and that the material will burn evenly.

Dr. Werner Kirchner, vice-president of Aerojet-General Corp., tells of an X-ray of a newly manufactured rocket combustion chamber that revealed, in the chamber wall, an employee's identification badge with its easily read name! Another radiograph, said to be at Cape Kennedy, shows a large steel nut in the middle of a rocket. A tiny, six-pound X-ray tube was designed to slip through a 3½-inch opening to check the integrity of 1300 brazed joints in the tightly packed plumbing of the Apollo Lunar Module.

Many consumer products are routinely X-rayed to protect you from foreign objects in everything from cosmetics to jelly beans. The technique even saved your wife's wash from black rubber that got into an entire day's production of a well-known detergent. Cloetta, a leading Swedish candy manufacturer, has used fluoroscopic examinations for 20 years. An average day's run of 3000 boxes usually reveals six boxes with suspicious objects. The company's technical director has collected 120,000 of these, including stones, chips of plaster, nails and screws of all sizes and shapes.

The flash X-ray technique, using a sudden burst of energy lasting one 50-millionth of a second, was originally de-

(Please turn to page 190)

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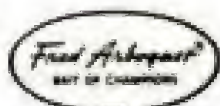


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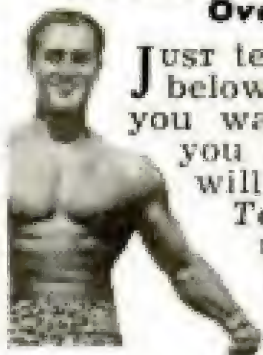
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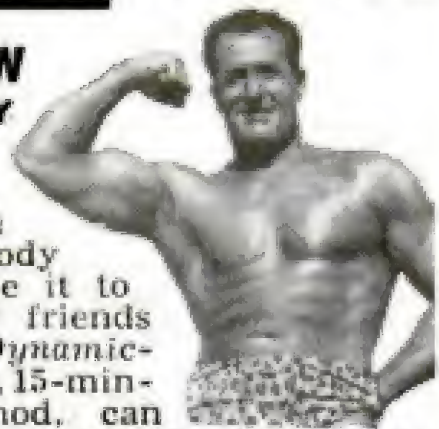
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HOW THEY KEEP YOU SAFE

(Continued from page 188)

veloped for research into space programs and ballistic weapons. It can "stop" objects traveling at speeds of more than 68,000 mph and obtains X-rays of bullets in flight. It now also tests the performance of such everyday items as hair-spray bottles.

Three-dimensional X-rays are being tried, and an Argonne National Laboratory team recently described the production of color radiographs. Since the eye is more sensitive to color than to shades of gray, these films give more precise definition and faster interpretation.

Ultrasonic NDT checks air safety

Ultrasonic testing is another NDT technique. In this method, electronically produced sound waves at frequencies far above the audible range are transmitted through liquids and metals at the speed of sound. The waves are reflected back to be displayed on an oscilloscope. Defects such as cracks, air pockets and bond failures deflect the waves and show up as sharp peaks in the trace pattern.

Your airplane safety is becoming ever more dependent upon ultrasonic NDT, which now checks the wings, wheels and landing gear. The world's tallest all-welded building, a 52-story skyscraper in Lower Manhattan, is also kept safe with ultrasonic NDT. Daily, it protects thousands of cars and trucks crossing the Cumberland Thruway Viaduct in Cumberland, Md. This was the first steel bridge structure to have all its critical field-welds checked by ultrasonics.

Bridges were once entirely riveted. After the rivets were inserted, an inspector would put his thumb on one side of the rivet and hit the other with a hammer. If he felt any kind of movement, the rivet was removed and another inserted. Only NDT has made possible the use of welded joints to build simpler, more delicate and yet stronger bridges that add beauty to America's landscape.

Still another NDT technique makes use of small eddy currents induced in metallic objects by applying a magnetic field. Any flaw in the material interrupts the eddy currents and shows up on a meter. Some 10 years ago, airlines were plagued by cracked wheel flanges that broke off in landing. With this new NDT method, cracks smaller than a $\frac{1}{64}$ th of an inch can be spotted. Every hour, Oldsmobile checks up to 10,000 critical bolts in its cars. Ford uses the same method to check automatic-transmission output shafts.

Magnetic-particle NDT reveals cracks

at or near the surface, but only with a metal that can be magnetized. Ferrous metal filings are sprinkled over the surface to be tested. They adhere to the material in a pattern representing lines of magnetic force. Any cracks disturb the magnetic field and produce a corresponding change in the pattern of filings. This test is used in more than 3000 U.S. manufacturing plants, from aircraft makers to petroleum producers.

One of the simplest forms of NDT is the dye penetrant, important for examining nonporous materials for surface defects. Some dyes are visible, others fluoresce brilliantly under special lights. Sprayed over a surface and then washed away, the telltale dye remains only where there are cracks or other faults to seep into, revealing their locations.

New method uses liquid crystals

One of the newest, and certainly the most colorful, of NDT methods uses liquid crystals. These amazing compounds pour like liquids but scatter light like crystals, changing color according to changes in temperature. They have proven sensors over a range from 5° below zero F. to 480° above, indicating differences as slight as .047°. Where tiny variations in temperature can signal a coming malfunction, these liquid crystals can spot the trouble quickly and surely. Unlike temperature paints, they can be used repeatedly, for the color changes are reversible.

Even newer tests are constantly being devised—like the use of microwaves to check your bowling ball for cracks. Picker Corp. has invented an X-ray machine that crawls through pipelines to check the joints. Tiremakers have long been faced with the problem of making sure that a tire is sound without cutting it open to find out. Now the Uniroyal people make holographic pictures—three-dimensional images created with a laser beam—of each tire as it swells slightly under pressure. If it expands uniformly, it's sound. But if there's the tiniest bump, blister or other irregularity, indicating an internal fault, the interference patterns produced by the reflected laser light spot it immediately.

NDT is truly the way of the future. Structures to be built on the moon and in space as orbiting platforms will probably be assembled by electron-beam welding and checked almost simultaneously by instruments monitoring the progress. Someday you will use a form of NDT to check out the condition of that house you're thinking of buying. And disasters like the Silver Bridge one will be unheard of. ★★★

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CHRIS-CRAFT'S LANCER

(Continued from page 114)

cruise into upper Biscayne Bay. Her deep-V hull parts the water like a knife. On my right I see the skyline of Miami. From this angle it looks like Chicago as seen from Lake Michigan. But it's not. A quick look to port and all thought of the North passes. There, sticking high into an azure sky, are the hotels of the Gold Coast—white and gleaming in the morning sun.

The water traffic in this area is terrific. There's everything—60-foot yachts; 110-foot Coast Guard cutters; fast, zipping hydrofoils; tugs of all sizes; steamers, and a replica of a Mississippi sternwheeler.

Now to the open water. The Bay of Biscayne is quiet today. Lancer charges at 4000 rpm over the smooth water. I noticed a slight vibration as the tach passed 3100. But it seemed to die out at 4000 revs.

I try some sharp turns and wake jumps. There's no question about Lancer's handling ability. She's neat, clean and solid.

It's about 6:00 in the evening as I nose up to the dock at Pennekamp State Park on the Atlantic side of Key Largo. I find that Lancer's walk-through windshield and sliding-bow hatch make it easier to cleat bow lines than it is in those boats that have no way to the bow.

Resting at the dock, I get a chance to give Lancer a full inspection. First, there's plenty of storage space under the foredeck and along the sides, even under the flooring. Two large storage cavities are big enough to install optional fish bins.

Besides storage space under the foredeck, there are two bunks and space for a head. Two fold-down lounge chairs are positioned in the cockpit.

One great benefit of Lancer's design is the low-profile engine cover. It does not fill the stern from floor to aft deck. This makes it easy to get to the bait well astern.

Checking workmanship, I find it's excellent.

After overnighting at Pennekamp, and then doing some early morning diving, I head back for Pompano Beach.

Returning through the open stretches of Biscayne Bay, I find Lancer behaves nicely. The eight-foot beam makes her quite stable. Her high freeboard—33¾ inches forward, 29½ inches aft—makes her a good open-water boat for ocean fishing.

One of the best features of Lancer's design is minimum bow-rise when getting on plane. At no time was my vision completely obstructed as is the case with many other boats when getting up on the step.

Lancer is a lot of boat for the suggested retail price of about \$7000. ★ ★ ★

'UPSIDE DOWN' TOOL BITS

(Continued from page 184)

upper end of the bracket is adjusted so it presses firmly against the plate, and oil is used to reduce friction as the plate slides beneath it.

Tests will indicate satisfactory speeds to use for various operations involving upside-down bits. For cutting-off work, the normal rpm often will be okay, although in the case of a very small, high-speed lathe, it was found that a reduced spindle speed was helpful in producing smooth cutting. And for all cutting-off work, a slow feed usually is best. Cutting lubricant should be used, particularly on steel, as for conventional machining.

It is important that cutoff tools be kept sharp and their positions properly adjusted. Production of a clean, easy flowing chip indicates when these conditions are about right. A cutoff tool can be ground in various ways: for instance, its tip can be angled so the piece separated will not have a taggle of metal at its center; and its sides can be ground to round the edges of either the cutoff piece or the remaining bar, or both.

How to avoid jamming

It is common practice to use a cutoff tool as close to the chuck or steady-rest jaws as practicable, say, no farther away than 1/2 in. for a 1/2-in. diameter bar. To reduce the likelihood of jamming and "collapsing" of the workpiece about the bit when the work is between centers, the parting tool can be used to cut most of the way through the workpiece, and a hacksaw employed to finish the cut after the lathe has been stopped. Jamming also has been attributed to such things as improper side clearance on the bit, too-fast feed, dull cutting edges and headstock-spindle play. If these conditions cannot be remedied, the operator may try to avoid jamming by cutting, in alternate steps, a groove wider than the bit while using plenty of cutting fluid (such as sulfurized oil for steel).

A conventional high-speed-steel cutoff bit has tapered sides for clearance. It is sharpened by grinding the end and top (bottom when inverted) surfaces. A newer type, used on turret lathes, is T-shaped in cross section, and is said to be easier to sharpen. Cutoff bits can be ground from standard square-section (or other) lathe-bit blanks.

Such blanks also can be ground to form upside-down tools for numerous other operations—such as beveling, rounding edges, grooving, turning to diameters, shouldering and producing fillets. ★★ ★

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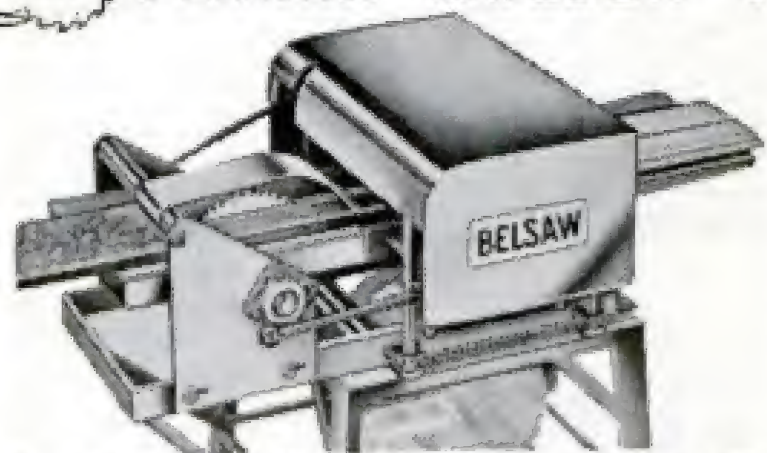
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OUTBOARD STARTING CHECK

(Continued from page 135)

ity that the ignition switch and its wiring, which technically aren't part of the starter system, could be bad and thus make starting impossible.

To test the ignition switch circuit, probe the "i" ignition terminal of the starter solenoid to ground with a 12-v. test light or voltmeter. If the light doesn't glow, it means that juice is not getting to the starter solenoid and, consequently, not to the safety switch either. There's a failure either with the ignition switch or with the wiring that extends from the switch to the starter solenoid.

If switch and solenoid check out, go to the starter motor. Connect a voltmeter to the starter motor terminal. Be sure to determine the polarity of your electrical system first. Generally, Mercury, Chrysler and OMC engines are negative-grounded. Thus, the positive lead of the voltmeter is connected to the starter motor terminal, and the negative lead of the meter is grounded.

Crank the engine and observe the meter. A reading of about 9.2 volts is normal. If the drop is excessive—let's say 7 volts or less—there's a problem inside the starter. It will have to be disassembled and checked for a dirty or worn commutator, shorted turns in the armature, damaged armature windings and condition of the brushes. Here's where you need the growler (Photo 11).

Check side play in starter drive

Before doing this, however, see if the starter drive is worn by checking it for side-to-side play. Play should be just about perceptible. Excessive movement indicates a worn starter drive.

Whether you want to have a bad starter motor repaired or buy another is something you'll have to decide for yourself, but sometimes it costs just as much to turn a worn and pitted commutator on a lathe, for example, as it does to buy a rebuilt starter motor. It's advisable to check prices. Naturally, only a single part, such as brushes or an armature, may be needed. Replacement parts for starters can be purchased.

Both electric and manual starters are practically maintenance-free. The only part that actually requires periodic servicing is the battery of an electric starting system.

Keep the top surface clean by flushing it with water every so often. Make sure posts and terminals are free of corrosion. And be sure the electrolyte is up to level at all times.

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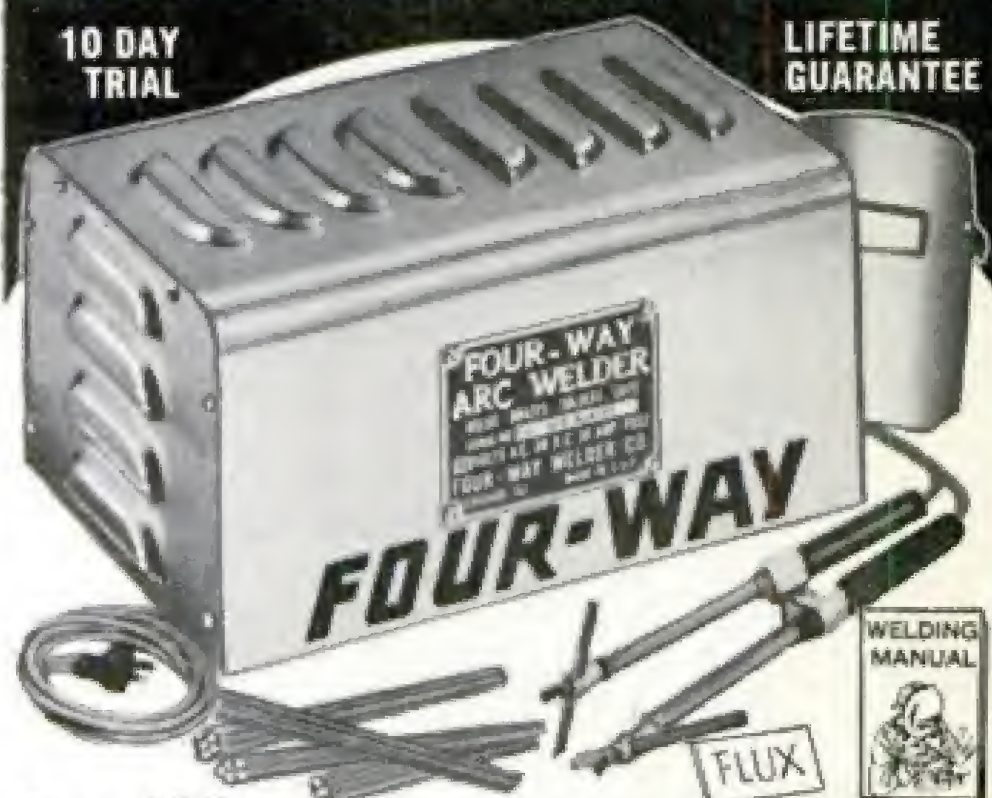
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AUGUST 1969

195

WAR GAMES

(Continued from page 87)

guns are programmed to cast their beams 3000 meters (about 3300 yards).

Every time a soldier squeezes the trigger for semiautomatic or automatic fire, a beam of invisible light is simultaneously fired with the blank ammunition. If necessary, the transmitter can fire up to 6000 rounds per minute, well in excess of any gun the Army has.

Every soldier in the maneuver is also outfitted with eight photodetectors—four on his helmet, two on his upper torso and two on the lower part of his body. They are tied in to the central computer station. Here's what happens when a rifle (or other weapon) is fired at a target:

Each gun has special code

The transmitter casts a beam of infrared light with its own special wave pattern (code). If the beam strikes a man, it's wide enough to strike one of the detectors.

The detector converts the coded beam to a coded current pulse—such as a particular series of dots and dashes—and amplifies and transmits it to the central computer station by means of a tiny preamplifier and RF transmitter each soldier carries in a hip pack. This equipment, which weighs about 20 ounces, is capable of sending the signal about a mile.

When it receives the coded pulse, the computer determines which man shot his weapon, which man was hit and the probability of kill. For instance, if the computer determines that the rifleman has used his allotted quota of ammunition, which is information that's programmed into the computer beforehand, it disregards the signal. The soldier-target, who doesn't realize he's been shot, is allowed to continue with the maneuver.

If the rifleman scores a hit, the computer records it and transmits an audible signal back to a small receiver inside the soldier-target's helmet or hip pack. This wailing signal tells the soldier that he's out of action. He's expected to fall down and play dead.

But just to make sure that he doesn't get exuberant and return to action, the signal from the computer also trips a flip-flop switch in his equipment that puts his laser beam transmitter out of commission. As far as the computer is concerned, he doesn't exist.

Essentially the same sequence of events occurs with equipment, such as a tank. However, there's a novel twist.

When a laser beam strikes one of a tank's 13 photodetectors, it discharges a smoke generator attached to the tank's

hull. Smoke comes billowing from the tank for 30 seconds, just as if it had been blasted by a live shell.

This points up why it's important that each weapon involved in the maneuver has its own special code. In combat, it would be ridiculous to think that a man with a rifle can knock out a tank. Thus, if a rifleman shoots a tank with his laser, the computer disregards the signal. If a tank or antitank weapon shoots a tank, the computer is programmed to recognize the signal.

The value of DFS is not just in its ability to provide realistic combat simulation. According to Gabe Schlisser of Holobeam, Inc., which has worked with the Army's Combat Development Experimentation Command in developing DFS, "DFS allows the training of troops under realistic combat conditions. A simplified version can be used to improve marksmanship."

DFS allows theorists to make judgments concerning tactics. It will help answer such questions as whether in a particular situation tanks should remain under cover or whether a particular formation is best.

There is, of course, a valuable spin-off to DFS. The laser-beam equipped system could allow two quarreling nations to fight a war and determine by computer who won—without a single soldier dying. ★★

MAVERICK VERSUS THE MOB

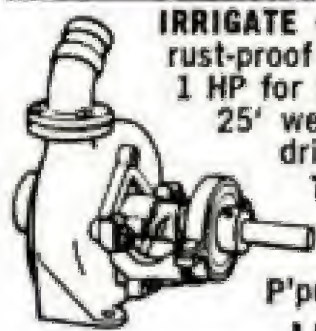
(Continued from page 77)

ferential isn't all-important, a prudent man would probably say "Yes." Maverick offers more room, more power, a bigger trunk, predictable handling, decent braking, good economy, attractive styling, comparatively easy serviceability, Ford dealers in every town and hamlet, a highly competitive price, and on and on, point-by-point down the line.

But in answering the second part of the question the Maverick encounters heavy weather. What it *doesn't* offer, sad to say, is *uniqueness*. Even its most enthusiastic advocates must admit it's a scaled-down Falcon, a *good* car, yet a car lacking in any one or two outstanding features that would endear it to those who would normally buy an import.

Years ago someone wrote a mash note to Volkswagen saying he liked his VW "because it *needs* me." Now that sort of appeal—that special sort of "come out and play with me" rapport offered by the imports to those willing to put up with their undeniable shortcomings—is as foreign to Ford's philosophy about the Maverick as the imports themselves. ★★

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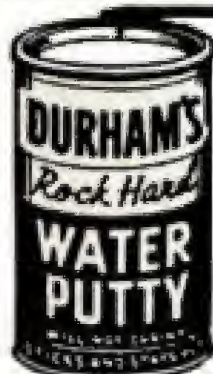
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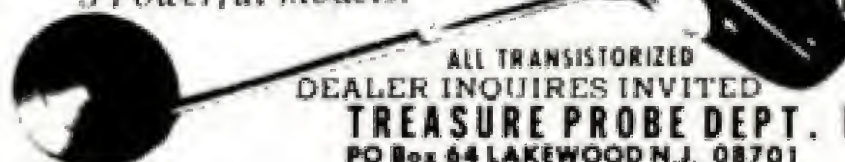
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WHO WILL BELL THE CAT?

(Continued from page 97)

show a temperature difference of a few degrees from the surrounding air.

Eastern Airline's meteorology department, working under contract to the FAA and Weather Bureau, investigated this angle in 1960. Data from more than 1000 flights indicated that when a plane encountered a sudden change of air temperature—either a drop or rise—the jet stream, CAT, or both, lay ahead. Planes traveling at three-fourths the speed of sound recorded a change of 2° F. per minute and a total change of 3.5° F.

For an instrument to spot such temperature changes, engineers turned to techniques of infrared detection and radiometers. This method is based on the principle that every object above absolute zero radiates infrared energy.

The black box in the airliner referred to at the beginning of this article is an advanced type of radiometer specifically designed for use in tracking CAT. The heart of the sensor is a thermistor, a metal strip whose electrical resistance changes in response to the radiant energy striking it. In this way, infrared energy is translated

**... a sudden change of air
temperature—the jet stream,
CAT, or both, lay ahead.**

into an electrical current that is metered to provide readings.

A "chopper," or fanlike mirror, is placed in the system so the detector receives regularly interrupted radiation from the outside target source. As the chopper blade intervenes, its mirrored surface reflects to the thermistor the radiation from a "black body" of controlled temperature. This provides a reference temperature with which the outside radiation is compared. By allowing radiation of selected wave lengths to enter the detector, which is done by filters, the distance of the radiation source can be determined.

A two-year test of a similar detection system was recently completed. A sailplane equipped with an infrared sensing device developed by the Barnes Engineering Co. made more than 150 flights over Mount Washington, N.H., and the Continental Divide. The sailplane was used because of its ability to withstand stress and its slow flight penetration into known areas of turbulence. The Barnes sensing device, researchers reported, detected temperature changes 25 miles away in di-

rect, horizontal line of flight. They also reported that temperature changes ranging from 3.5° F. to 9° F. were found to be a "constant characteristic of clear-air turbulence."

For the last six months of the project a sensor was tested in a Pan Am Boeing 707 to determine if warning temperature changes could be detected far enough ahead of a plane moving at 600 mph to take evasive action. Results were encouraging. At this writing, Pan Am, Eastern, TWA and United plan to carry out a two-year program in which the Barnes infrared sensing device will be tested on regular passenger flights.

Another detector, made by the Autonetics Div. of North American Aviation, was used in a number of test flights in 1966 and 1967. North American's engineers reported that they received advance warning in 13 out of 14 encounters with CAT. The average warning time was three and a half minutes and the maximum detection range was reported as 48 miles.

Although it seems promising, there remain drawbacks to infrared detection. One handicap is that it does not indicate the severity of turbulence. Another is its relatively limited range. A critical minimum warning for a subsonic jet is considered to be 20 miles, or two minutes. If the plane were an SST cruising at 2000 mph, the range of the best detectors being tested today would have to be doubled to be effective.

The detector may also sound false alarms when it senses distant aircraft or other sources of radiant energy.

Another factor to consider in the use of any detector is that all high-flying craft are now on tightly controlled instrument flight plans. Except in an emergency, to deviate from these plans requires explicit permission from ground controllers. A diversion in course or altitude by one plane to avoid CAT could affect many other aircraft which are following or approaching that plane's route.

Clear-air turbulence is recognized as one of those obstacles which are discovered and overcome as each new aviation frontier is opened. Though a good start has been made toward belling the CAT, the full potential of supersonic air travel may not be realized until the job is completed. ★★★

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TV IN EVERY ROOM

(Continued from page 129)

metal pipes and heating ducts, without fear of interference.

If you decide on coaxial cable, you may need to add a small matching transformer between it and the antenna to match the cable's 75-ohm impedance to the antenna's 300-ohm impedance. This is inexpensive and simple to install. If your antenna has been up for a while, it's pretty safe to assume you'll need one. At the other end of the line, you'll need another transformer to convert the cable's 75-ohm impedance back to 300 ohms to match the input on the TV set or FM radio. This also has another function. It divides the VHF and UHF frequencies so you can feed the signals to separate inputs on TV sets that have provision for receiving both VHF and UHF channels.

Splitters and couplers come with connections for either 300-ohm twinlead or 75-ohm coaxial cable. Pick the type that matches the system you decide to use. Wall outlets are also available in a choice of connections. You can plug in either 300-ohm twinlead or a 75-ohm coaxial line



Keep all cables as short as possible, especially the main downlead

depending on your system. Some offer a combination of outlets—one 75-ohm connection for a TV set and one 300-ohm one for an FM radio. In this case, there's a built-in transformer for the 300-ohm FM outlet, but you still need a transformer at the TV set for the 75-ohm line.

In shopping for parts, you'll probably come across a special wall outlet called a "tapoff." This is designed for systems in which all outlets are connected together in a continuous string instead of being on individual branch lines. It has some advantages for use in large apartment buildings, but is not needed in small home jobs and is more complicated to install as you have to calculate the signal drop from outlet to outlet.

In laying out your system, keep all cables as short as possible, especially the main downlead from the antenna. Mount the distribution amplifier as near as you can to where the downlead enters the house—preferably in the attic, if possible. The amplifier operates on house current and will need a 115-volt outlet nearby to plug into.

Be sure there's a lightning arrester between your antenna and the amplifier. A

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few amplifiers have built-in lightning-discharge protection, but even these will be better if they are protected by an outside arrester.

Two outlets per room are desirable, with more recommended for a large living room or playroom to give you flexibility in moving furniture around. The outlets are designed to fit into standard electrical wall boxes, but they can be clamped into wall openings with special clips, eliminating the metal boxes. You can also surface-mount them if you'd rather not cut openings in your walls.

If you're using twinlead, don't run your lines near each other for more than a few feet as the interaction of signals between them can impair your reception. Also, you'll need insulated standoffs to support twinlead. Coaxial cable can be fastened directly to joists, baseboards and other surfaces with no problem. There are special clips for this.

The only tricky part about using coaxial cable is in preparing the ends for making connections. The shielding must be rolled back and a collar crimped on with pliers or a special crimping tool. You can usually rent or buy the crimping tool from the store where you get the parts. You can also buy cables with connectors already attached in 10, 50, 75 and 100-foot lengths. These are handy if they happen to match the lengths you need, but don't permit a lot of excess cable—that just wastes signal power.

Twinlead is even simpler to attach—you don't have to strip off the insulation in most cases. You just slide the end under two serrated washers and tighten the washers down with screws. The serrated edges bite through the insulation and make contact with the wires.

How much your MATV system will cost depends, of course, on the size of your house and the number of outlets you want. Distribution amplifiers providing four outlets sell for about \$20 to \$45. Passive splitters go for \$8 to \$12. Wall outlets vary from about \$1.50 to \$3.50 depending on the type. Antenna-matching and set-matching transformers are \$4 to \$6. Twinlead costs only a few dollars for a 100-foot roll, but coaxial will run you \$15 to \$20 for the same amount.

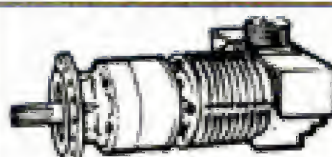
The nice thing about a MATV system is that you don't have to buy it all at one time. You can start with a simple splitter, then replace it with an amplified coupler later on, using the splitter in one of the branch lines. The system is so flexible that you can rearrange or add to it at any time as your requirements change without wasting any of the work you've already put into it. ★ ★ ★

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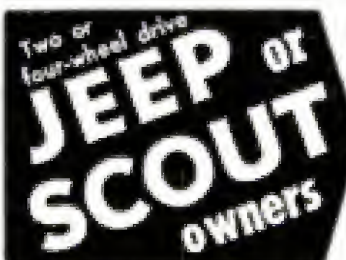
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REAR SIDE OF ENGINE shows exhaust outlet alongside cylinder. Gear serving as flywheel in original model could be lathe-turned disc of brass or steel

MODEL WALKING-BEAM ENGINE

(Continued from page 159)

cesses for the screwheads. Now drill through the center reference point and tap 10-32 for the valve pivot. Put a gasket between the port face and cylinder side.

Machine the upper and lower cylinder covers from Dural. Use the cylinder as a ring gauge to check the register diameters. Drill the covers for the mounting screws, then spot the cylinder ends from the covers and drill and tap for the mounting screws.

Chuck a piece of Dural for the piston, drill through for the piston rod and machine the packing groove. Bring the o.d. to about .0002 in. oversize. Make the piston rod and mount the piston on it. The piston is held in place by a thin nut ($\frac{3}{16}$ -in.) on either side. Next, chuck the piston rod with the piston on it and, with a very sharp tool, skim the piston to finish diameter.

Pack the piston with graphite-asbestos string rolled into the groove. Use commercial packing split down fine. Assemble the cylinder and covers with the piston in place and gaskets under the covers. Put some packing into the stuffing box and screw in the gland.

Fit the piston-rod eye to the rod with a locknut on the rod. You can now mount the cylinder on the bedplate by means of 4-40 screws through the big holes in the lower cover. Connect the piston-rod eye to the main link by its lower pin. Gently rotate the crankshaft to adjust the piston rod in the eye. Its length must be such that the piston will not contact the covers at the ends of the stroke. When you have

added the steam inlet flange and exhaust fitting to the port face, you are ready to tackle the valve and its associated parts.

Make up the valve pivot first and screw it right into position in the port face. Mark out the valve on a piece of $\frac{3}{16}$ -in. brass and work from the pivot center as your reference point. Steam grooves in the valve face are best formed by end-milling with a $\frac{1}{16}$ -in. dental burr. Set up a false pivot by mounting a $\frac{3}{16}$ -in. rod horizontally on the lathe saddle. Mount the valve on the pivot with its face toward the headstock and the mill gripped in a chuck. Set the pivot $1\frac{9}{16}$ in. off center to correspond to the radius of curvature of the groove. Feed the work in slowly, rotating the valve manually on the pivot through the proper angle. Lap the valve face and port face with jeweler's rouge to make the joint steam tight. Mount the valve on the pivot, holding it against the port face with a light spring and nut.

Chuck a piece of brass for the eccentric, and machine the o.d. and the groove for the retaining screw which prevents the eccentric strap from moving sideways. Then sever with a parting tool. Use the center mark from parting off as a reference point to locate the crankshaft opening. The setscrew must pass through the broad part of the eccentric.

Put a locknut on each end of the eccentric rod for length of adjustment. Use a shouldered screw for connecting the eccentric rod's small end to the valve.

Making final assembly

Mount the eccentric on the crankshaft in any position for now and hook up the valve through the eccentric strap and rod. Adjust the length of the eccentric rod so that the division between the steam grooves in the valve face will move equal distances back and forth across the ports on the vertical centerline of the port face as the crankshaft is rotated. The last adjustment is the eccentric position relative to the crank. The eccentric should form an angle of about 165° to the crankpin. Adjust it so that the valve will be just starting to admit steam to the appropriate port when the piston is at the end of its stroke and is about to change direction.

My lathe is not big enough to handle the flywheel, so I hunted around and found the old gear which serves admirably. With a heavy flywheel and long stroke, the engine runs very smoothly on either air or steam. The proper operating speed for a beam engine is 50 to 60 rpm.

Complete plans detailing each part of the model can be obtained for \$3.50 from Beam Engine Plans, 691 Garretson Road, Somerville, N. J. 28876. ★★

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